Aseptic technique: a mixed methods study exploring undergraduate nursing students' education and training in the United Kingdom

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Summary

Aseptic technique is a core nursing skill. Improving education in aseptic technique is a key strategy to prevent healthcare-associated infection and anti-microbial resistance. A systematic literature review found a dearth of research into nursing students' learning of aseptic technique.

A mixed methods, sequential, explanatory study design was used to investigate nursing students' education and training in aseptic technique in pre-registration programmes in the United Kingdom. In phase one, 70% (n=49/70) of universities responded to a telephone survey exploring education in aseptic technique. In phase two, an embedded multiple case-study explored students' learning of aseptic technique in two contrasting cases (universities and associated National Health Service Trusts). In-depth telephone interviews were conducted with a purposive sample of students (n=15), mentors (n=11), nurse educators (n=7) and infection prevention nurses (n=14); university teaching observed (n=11) and documentary evidence (n=19) gathered across two case-study sites. Interview data underwent thematic analysis and content analysis was used for observation data and documentary evidence.

The phase one survey found a blended learning approach, with aseptic technique taught applied to different clinical procedures. Wide variation in teaching time; use of multiple guidelines; inaccuracy in the principles taught; and limited opportunity for competency assessment was apparent across programmes.

The phase two case-study findings revealed three main themes: Different knowledge, understanding and practices, Influences upon learning and practice and Relationships, roles and responsibilities to support safe and effective practice and eight sub-themes.

Education in aseptic technique for students and qualified nurses requires improvement. The literature identified the need to develop a working definition of aseptic technique. The generalisability of these findings in other healthcare disciplines needs to be explored.

Declaration

This work has not been submitted in substance for any other degree or award at this or any other university or place of learning, nor is being submitted concurrently in candidature for any degree or other award.

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This thesis is being submitted in partial fulfillment of the requirements for the degree of PhD

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This thesis is the result of my own independent work/investigation, except where otherwise stated, and the thesis has not been edited by a third party beyond what is permitted by Cardiff University's Policy on the Use of Third Party Editors by Research Degree Students. Other sources are acknowledged by explicit references. The views expressed are my own.

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Dedication

This is for my Mum, Christine (1944-2014). She would have been so proud of me and told everybody in Marks & Spencer!

Chapter 1- Introduction

1.0 Introduction

The impetus for this study arose through the experience of teaching clinical skills to pre-registration nursing students. Students frequently reported differences between what they were taught about aseptic technique in university and what they observed or were taught in clinical practice, corroborating the findings of earlier research (Ward 2010; 2011). The importance of teaching infection prevention generally, and aseptic technique in particular to undergraduate nursing students is emphasised in national and international policy (Department of Health (DoH) 2003a; 2014b; World Health Organization (WHO) 2016a). Despite its importance, nursing students' competency in infection prevention has not received the same attention as other core nursing skills for example: communication, assessment and management of very sick patients (Chant et al. 2002; Connell et al. 2016; Maclean et al. 2017; McDonald et al. 2018). Research exploring nursing students' education and training in aseptic technique is sparse (Davey 1997; Gonzalez and Sole 2014; Carter et al.2017).

Aseptic technique is one of many core skills that nursing students are required to learn (Nursing and Midwifery Council (NMC) 2010; NMC 2018a; Nursing and Midwifery Board of Australia 2013). Competency in aseptic technique is a professional requirement in the United Kingdom (UK) (NMC 2010; NMC 2018a). The aim of this study was to explore when, what and how pre-registration nursing students learn aseptic technique and are taught and assessed. Numerous definitions of aseptic technique exist and are discussed in Chapter 2. Wilson's (2006) definition of aseptic technique was chosen to be applied throughout the thesis as it was the most accurate, realistic and succinct definition (see Section 2.2.2). The chosen definition of aseptic technique is:

"To minimize the risk of introducing pathogenic organisms into a wound or other susceptible site and to prevent the transfer of pathogens from the wound to other patients or staff" (Wilson 2006, p. 192).

A comprehensive investigation of nursing students' education and training in aseptic technique in undergraduate, pre-registration programmes was undertaken. Pre-registration nursing programmes are programmes leading to entry to practice. In-depth exploration of nursing students' and qualified nurses' understanding of aseptic technique has not been previously undertaken within a single study. Inaccurate and

incomplete understanding of aseptic technique has been reported in qualified nurses (Hallett 2000; Gould et al. 2017a) and nursing students (Davey 1997). If qualified nurses have poor understanding of aseptic technique this is likely to be passed on to nursing students through education. This study contributes to the literature in this area, thus filling an important gap in the literature.

Nurses are identified as leaders of infection prevention (DoH 2014). Nursing students are the next generation of nurses. They have an important future role in reducing health-care associated infection (HCAI) and risks of antimicrobial resistance. Improving infection prevention practices including aseptic technique is a key strategy for reducing HCAI and antimicrobial resistance globally (O'Neill 2016; WHO 2016a; 2016b). The need to enhance aseptic technique practices through nurse education supported the rationale of this study (DoH 2003; DoH 2014; WHO 2016a; DoH 2019).

This chapter will discuss international and national policy to reduce HCAI and the risks of antimicrobial resistance. The chapter is presented under eight sections. The first and second sections will describe the challenges of HCAI and antimicrobial resistance respectively. The role of aseptic technique in preventing HCAI and reducing the risks of antimicrobial resistance will be explored in the third section. The fourth section will discuss nurses' role in infection prevention. National policy, campaigns and initiatives to improve infection prevention practices and reduce HCAI rates in the UK will be discussed in chronological order in the fifth section. The sixth section will review national policy and guidelines for education, training and assessment in qualified health professionals, including nurses. The penultimate section will discuss the introduction of the aseptic non-touch technique (ANTT) Clinical Practice Framework (The Association for Safe Aseptic Practice (ASAP) 2016) to standardise aseptic technique practice. A summary of the chapter is provided and then followed by an overview of the structure of the thesis.

1.1 The challenges of health-care associated infection

HCAI is defined as "An infection occurring in a patient during the process of care in a healthcare facility which was not present or incubating at the time of admission" (WHO 2016a, p. 7). HCAIs are considered to be avoidable through effective infection prevention precautions (DoH 2003; WHO 2016a; 2016b). The importance of reducing HCAI is unequivocal. HCAI is a global burden, and one of the most frequently reported adverse events in healthcare (WHO 2016a; 2016b). The human

and economic costs are immense. HCAIs extend hospital stay, increase the risk of complications, morbidity, mortality and antimicrobial resistance (WHO 2016b). Approximately 7% and 10% of patients in developed and developing countries respectively will acquire at least one HCAI (WHO 2016a). In the UK, significant reductions in HCAI rates were achieved between 2006 to 2011, with reported HCAI rates in 2011 of 4.3% for Wales; 4.9% for Scotland; and 6.4% for England. While declining rates of HCAIs in the UK are encouraging, improving health professionals' infection prevention practices remains challenging (National Audit Office 2000,2009; Welsh Government 2011; National Institute for Clinical Excellence (NICE) 2012).

1.2 The challenges of antimicrobial resistance

Antimicrobial resistance occurs when micro-organisms prevent antimicrobials from working, meaning that usual treatments become ineffective, infections persist and may spread to those at greatest risk, i.e. the very sick (WHO 2017). Antimicrobial resistance makes infections harder to treat in sicker patients with co-morbidity, and also the ageing populations (Davies 2013; O'Neill 2016). Antimicrobial resistance is a natural process which has been accelerated by the misuse of antibiotics in healthcare, veterinary care and husbandry of healthy animals. Infection prevention is considered the best defence against antimicrobial resistance, reducing the need for antibiotics (DoH 2003; DoH 2014; O'Neill 2016; Scottish Government 2016; WHO 2016a; 2016b; DoH 2019). Steps taken to tackle antimicrobial resistance include: increasing public awareness through education; educating health professionals and students; improving infection prevention practices and good antibiotic stewardship (DoH 2014; Health Improvement Scotland 2015; WHO 2015; O'Neill 2016; DoH 2019). This thesis addresses two of these areas: nursing students' education and training in aseptic technique and improving infection prevention practices.

Antimicrobial resistance is a serious global public health issue (DoH 2014; WHO 2016a; 2016b; DoH 2019). In Europe, 25,000 people are estimated to die annually from HCAIs caused by resistant bacteria (DoH 2014). Deaths attributed to antimicrobial resistance each year are forecasted to increase globally from 700,000 to 10 million by 2050 (O'Neill 2016). O'Neill (2016) predicts, that if ignored, the human and economic costs of antimicrobial resistance will rise. The cost of global action is estimated to be approximately 32 billion pounds over a 10-year period. The cost of inaction will exceed the cost of interventions to tackle antimicrobial resistance.

The next section will explore the role of aseptic technique in preventing HCAI and antimicrobial resistance.

1.3 Role of aseptic technique to reduce health-care associated infection and antimicrobial resistance

Policy identifies three key strategies for reducing HCAI and the risks of antimicrobial resistance which are of relevance to this study. These strategies include the need to improve infection prevention practices, the need for well-defined activities and guidelines for infection prevention, and the enhancement of education and training (DoH 2014; 2015b; O'Neill 2016; WHO 2016a; 2016b; DoH 2019). The recent UK 5-year action plan for tackling antimicrobial resistance 2019-2024 (DoH 2019) continues to focus upon improving infection prevention practices. Both the previous UK strategy and current 5-year action plan for tackling antimicrobial resistance identify improving infection prevention practices through training of healthcare workers in aseptic technique (DoH 2014; DoH 2019).

Aseptic technique is central to patient safety (DoH 2003; 2005c; Royal College of Nursing (RCN) 2012b; DoH 2014; WHO 2016a; 2016b). Over fifteen years ago, the importance of aseptic technique in reducing HCAI was recognised (DoH 2003). Little progress has been made in improving aseptic technique practices, and it remains a priority today (WHO 2016a). Aseptic technique has not received the same research attention as other infection prevention practices, such as hand-hygiene (Gould et al. 2017c).

Aseptic technique is an important component of high impact interventions, care bundles to reduce infections associated with urinary catheters and intravascular access devices (Loveday et al. 2014; Infection Prevention Society 2017). High impact interventions are an evidence based approach to clinical procedures or care processes, that if performed properly can reduce the risk of infection (Infection Prevention Society 2017). Care bundles identify the critical elements of particular clinical procedures or care processes and key actions required to reduce the risk of infection (Loveday et al. 2014). Care bundles are multi-faceted making a demonstrable relationship between aseptic technique and the reduction of infection difficult to prove (The Health Foundation 2015). Increasing demands, busy and overcrowded hospital environments pose key challenges for infection prevention (Davies 2013). Good aseptic technique practices by healthcare professionals when

caring for vascular and urinary catheters have been recognised as important in maintaining a safe environment and reducing infection risk (Davies 2013).

Aseptic technique is a core component of infection prevention programmes (WHO 2016a). All acute healthcare services are recommended to have an infection prevention programme, with a designated trained team specifically to prevent HCAI and the risks of antimicrobial resistance through good infection prevention practices (WHO 2016a). Maintaining safe and effective aseptic technique during healthcare procedures is identified by WHO (2016a) as a core activity. The importance of national standards for infection prevention and the development and implementation of evidence based guidelines for infection prevention including aseptic technique is identified (WHO 2016a).

Enhancing education and training for healthcare professionals and students has been recommended for improving infection prevention practices (DoH 2003; DoH 2014; Health Improvement Scotland 2015; WHO 2016a; DoH 2019). Education and training in infection prevention for healthcare professionals is an integral part of infection prevention programmes (DoH 2003; DoH 2014; WHO 2016a). This should include education and training on guidelines for aseptic technique (DoH 2003; WHO 2016a). It is advised that infection prevention education for healthcare professionals should be participatory through bedside and simulation training in healthcare organisations (WHO 2016a).

Several recommendations have been made for improving undergraduate education including the need for greater emphasis upon infection prevention and antimicrobial resistance in undergraduate nursing curricula (DoH 2003; DoH 2014). National policy is less clear about where and how this should be achieved. The need to strengthen the evidence base for enhancing education and training is recognised (WHO 2016a). Greater collaboration and sharing of knowledge and understanding between academics and clinicians with regards to infection prevention has been advocated (DoH 2014; WHO 2016a). The WHO (2016a) states that national infection prevention curricula should be developed for undergraduate programmes in collaboration with higher education institutes.

1.4 Role of nurses in infection prevention

Nurses are the largest professional group working in direct patient care. Nurses at every level, from healthcare assistants who deliver day to day care, to qualified nurses who delegate and provide care, and to Directors of Infection Prevention and

Control or the equivalent, have a central role in infection prevention (RCN 2014). Nurses delivering day to day care must ensure they adopt good infection prevention practices adhering to current guidelines. Link nurses act as positive role models for infection prevention in clinical areas, increasing awareness, motivating others to learn and adopt good practices whilst supporting audit and surveillance (Dawson 2003; RCN 2012a; Centre for Workforce Intelligence 2015). Champions create a culture where good infection prevention practices are integrated into everyday practice (The Health Foundation 2015; Zingg et al. 2015). Nurses make effective link practitioners (Sopirala et al. 2014) and champions and leaders of infection prevention (Marra et al. 2010). Nursing students need to be well prepared to take on any of these roles in the future. Infection prevention practices such as aseptic technique therefore need to be taught effectively.

Infection prevention specialist nurses and teams are responsible for ensuring the infection prevention programme is delivered; including educating staff and ensuring they implement infection prevention guidelines; surveillance and investigating outbreaks of infection (Jenner and Wilson 2000; Wilson 2006; Centre for Workforce Intelligence 2015). Directors of Infection Prevention and Control in England, oversee the infection prevention team and implementation of infection prevention policies and report upon HCAI directly to Chief Executive and Trust Board (DoH 2003; 2015a). In Wales, there is a lead infection prevention and control doctor and an executive lead for Infection Prevention and Control (Director of Nursing/Assistant Director of Nursing - Infection Prevention and Control) who would report to the board (Welsh Government 2014). Similarly, in Scotland there is a dedicated infection prevention and control team with a Lead Infection Prevention nurse in each NHS Board who might report directly to the Health Associated Infection (HIA) Executive Lead or to a Director or Associate Director for Infection Prevention who reports to an Infection Manager who reports to the Health Associated Infection (HIA) Executive Lead (Health Improvement Scotland 2015). The following section will discuss the efforts made to reduce infection rates in the UK, through national policy, guidelines, campaigns and target setting.

1.5 Reducing infection rates in the United Kingdom

The catalyst for action and interventions to reduce HCAI in the UK will be discussed in chronological order, to provide an historical perspective. In the last 15 years, reducing HCAI and improving infection prevention in the NHS has been high priority (The Health Foundation 2015). Success in reducing HCAI in England has been

attributed to target setting and a performance management approach for infection prevention (The Health Foundation 2015; Brewster et al. 2016). Action to improve infection prevention and reduce HCAI came following the introduction of clinical governance (DoH 1997; DoH 1998). Two national prevalence studies highlighted the insufficient progress made in reducing HCAI over a ten-year period (Meers et al. 1981; Emmerson et al. 1996). Damning media reports about poor cleanliness in British hospitals emerged. Public uproar culminated in political pressure to improve standards of cleanliness and reduce HCAI (Desai et al. 2000). Investigations into the costs and management of HCAIs were publicised, increasing public support for controlling HCAI (Plowman et al. 1999; National Audit Office 2000; Plowman et al. 2001). This sparked national guidelines for preventing HCAI (Pratt et al. 2001; NICE 2003) which have since been updated (NICE 2012; Loveday et al. 2014).

Mandatory surveillance and national targets for HCAIs began with meticillin-resistant *Staphylococcus aureus* in 2001 and 2004 respectively (DoH 2001a; 2004). Many different initiatives and campaigns to improve infection prevention practices followed (The Health Foundation 2015). Saving lives, Reducing Infection, Delivering Clean and Safe Care (DoH 2005b) first introduced seven high impact interventions, including care bundles to prevent HCAI. It was recognised that infection risk could be reduced if healthcare professionals applied evidence based practice guidelines every time they undertook a clinical procedure. The aim was to minimise variation in healthcare professionals' practice by identifying and measuring compliance with the critical components of the procedure. The Health Act 2006; Code of Practice for the prevention and control of infections (DoH 2006) mandated that all healthcare providers must have registration with the regulator and protect against HCAIs. An update in 2008, made it a requirement that all NHS organisations registered with the Care Quality Commission and had a duty to protect patients against HCAIs (DoH 2008b). Clean, Safe Care: Reducing Infections and Saving Lives (DoH 2008a) stipulated that all NHS staff have a vital role to play in infection prevention.

Despite these policies and legislation, the Robert Francis Inquiry Report into Mid Staffordshire NHS Foundation Trust reported failings in cleanliness, with poor infection control practices increasing the risk of HCAI (Francis 2010). There was criticism that concerns about poor attitudes towards infection prevention were not addressed (Francis 2013). This brought about two key recommendations. The first recommendation was that the Health Protection Agency or successor should co-

ordinate, analyse and publish each healthcare provider's performance in relation to HCAI. The second recommendation was that concerns about the management of HCAI must be shared and reported to NHS Commissioning boards and the Care Quality Committee in England or equivalent such as the Board or NHS Boards and Care Inspectorate in Wales and Scotland respectively.

The subsequent section will discuss the policy drive for the provision of education, training and assessment for aseptic technique in qualified health professionals in the UK.

1.6 Education, training and assessment in aseptic technique

The need for health professionals to be educated, trained and assessed as competent in aseptic technique in the UK has been recognised for some time (DoH 2003; 2006; 2008; RCN 2012b; NICE 2012; Loveday et al. 2014; Welsh Government 2014; DoH 2015). However, national policies and guidelines do not go beyond making the recommendation for education, training and assessment. The Health and Social Care Act 2008: Code of Practice on the prevention and control of infections (DoH 2015), states that the principles of asepsis should be followed during clinical procedures and staff compliance with aseptic technique audited. The frequency or nature of audit is not specified. There has been considerable variation in the way aseptic technique has been defined in the literature and national policy and guidelines (See Chapter 2). If there is no clarity about what aseptic technique entails, as apparent from the definitions evaluated in Chapter 2 (see Section 2.2.2), this may have implications for education, training and assessment. The following section will discuss a national initiative to standardise aseptic technique practice in the UK.

1.7 Aseptic Non-Touch Technique (ANTT): the drive to standardise aseptic technique practice in the United Kingdom

Aseptic Non-Touch Technique (ANTT) is an approach to undertaking aseptic technique characterised by the underlying principle of protecting key parts and key sites from contamination (Fraise and Bradley 2009). The ANTT Clinical Practice Framework was developed by NHS practitioners in the 1990s to improve and standardise aseptic technique practices. It consists of a set of principles and safeguards for aseptic technique to be applied during all invasive procedures. ANTT appears to be originally conceived mainly for use during the insertion and

management of intravenous lines. The implementation of ANTT involves an initial audit of practice; education and training and annual assessment (Rowley 2001).

The ANTT framework was first recommended in national guidelines for preventing healthcare-associated infections in NHS hospitals in England (Pratt et al. 2007) and later recognised in NICE Guidelines (2012). The ANTT Clinical Practice Framework has been mandated for use in Wales, UK (Public Health Wales 2017). It is claimed to have been widely adopted (The Association of Safe Aseptic Practice (ASAP) 2016). ANTT is recognised as best practice in Australia (National Health and Medical Research Council 2010), Wales (Public Health Wales 2017) and Ireland (Health Protection Surveillance Centre 2011).

Policy makers in England recognise the contribution ANTT makes in reducing practice variation and developing competence, but acknowledges the lack of high quality comparative evidence of the efficacy of ANTT compared to other approaches to aseptic technique (Loveday et al. 2014). The evidence is low, i.e. level 4 based on expert opinion and clinical standards, according to the adapted Scottish Intercollegiate Guidelines Network (SIGN) (2011) hierarchy of evidence used in the epic 3 guidelines. This equates to level 5 on Sackett's (1989) hierarchy of evidence. While ANTT has found favour among policy makers and managers, further independent evaluation is necessary to assess its effectiveness and utility and acceptability to practitioners.

1.8 Summary

The importance of reducing HCAI and the risks of antimicrobial resistance is indisputable. National and international policy and guidelines strongly recommend improving infection prevention practices, including aseptic technique, to reduce HCAI and the risks of antimicrobial resistance. The policy drive to standardise aseptic technique, and for health professionals to be educated, trained and competent, originally came from England. Education and training for healthcare professionals, infection prevention guidelines including aseptic technique and maintaining effective aseptic technique in healthcare organisations are core components of infection prevention programmes. The need to improve infection prevention education in undergraduate programmes has been recognised (DoH 2003; 2014b; WHO 2016a). Sharing knowledge and understanding of infection prevention between clinicians and academics has been recommended (DoH 2014; WHO 2016a). These policy recommendations support the need for this study to

explore what and how nursing students learn aseptic technique and are taught and assessed. Pre-registration programmes need to provide a solid foundation for nurses' aseptic technique, knowledge, understanding and skills. This thesis will explore nursing students' learning and understanding of aseptic technique. The next section will outline the structure of the thesis.

1.9 Structure of the thesis

The thesis has eight chapters. Chapter Two explores the aim, definitions, principles and practices of an aseptic technique as described within the literature. An overview of competency-based education is presented and what and how nursing students learn aseptic technique and are taught and assessed in pre-registration nursing programmes is discussed in Chapter Three. A systematic review of the core literature on nursing students' education, training and assessment in aseptic technique is presented in Chapter Four. Chapter Five explains the methodological approach and methods used in each phase of this two phased mixed-methods, sequential explanatory study design. Chapter Six presents the results of the phase one, quantitative survey findings. Chapter Seven presents the phase two case-study qualitative findings including thematic analysis of interviews and content analysis of documents and observations. A discussion of the study findings, limitations and implications for nursing practice, education and research are presented in Chapter Eight.

Chapter 2 - Origins, definitions, principles and practice of aseptic technique

2.0 Introduction

Chapter Two begins with an exploration of the origins of aseptic technique. The different terms, aims and definitions associated with aseptic technique are then reviewed. This is followed by a discussion of the principles of aseptic technique. Finally, qualified nurses' understanding and practice of aseptic technique is explored.

2.1 Historical overview

The origins of aseptic technique can be traced back to Joseph Lister's work in the Glasgow Royal Infirmary in the nineteenth century (Ayliffe and English 2003). Lister provided evidence that infection can be avoided if surgical wounds are protected from contamination. This principle has since been applied to other susceptible sites e.g. intravascular devices and remains pertinent today, at the heart of aseptic technique and ANTT. Lister observed that gangrene and septicaemia were common in two wards in the Glasgow Royal Infirmary. Lister used his knowledge of the effect of carbolic acid (phenol) an antiseptic, upon sewerage and applied it to surgical wounds, dressings and instruments in the operating theatre. A natural experiment showed that mortality rates were reduced by approximately a third, from 45.7% (16/35) to 15% (6/40) following the introduction of his antiseptic methods. These results were achieved by Lister, without any other precautions (Ayliffe and English 2003).

European surgeons adopted Lister's methods of antiseptic surgery. The end of the century marked the transition from antiseptic to aseptic surgery in operating theatres and ward practice (Ayliffe and English 2003). In Lister's time, Neuber and other surgeons used elements of aseptic surgery, wearing hats and gowns in operating theatres. By the end of the nineteenth century sterile gloves, face masks and other protective gloving and sterilised instruments were routinely being used as part of aseptic surgery.

2.2 Terms and definitions associated with aseptic technique

This section will explore different definitions of asepsis, aseptic technique, aseptic non-touch technique and clean technique in the literature. Different terms associated with aseptic technique: sterility, disinfection and cleaning will be defined

following discussion of the hierarchy of decontamination (Wilson 2006). Finally, the use of these different terms will be discussed.

An audit trail of the definitions of asepsis, aseptic technique, aseptic non-touch technique and clean technique was undertaken. The process involved the identification of various definitions in a wide range of literature, and locating the origins of each definition. Where possible, all definitions were traced back to their original source. Potential definitions were sourced using my experience as a lecturer in teaching clinical skills, scrutiny of pre-registration curricula and from learning resources made available to NHS staff. Definitions were extracted from a range of clinical skills textbooks and e-learning resources known to be used to support learning in pre-registration programmes and continuous professional development in NHS organisations. Other definitions came from infection prevention textbooks recommended for undergraduate nursing students and continuing professional development articles in popular nursing journals, likely to be accessed by nurse educators, qualified nurses and students. Definitions of aseptic technique were also extracted from national and international policies for HCAI and antimicrobial resistance. Definitions are presented in chronological order in Tables 1-5.

2.2.1. Definitions of asepsis

Many different definitions of asepsis exist (see Table 1). The definition of asepsis used by Loveday et al. (2014) referenced as Wilson (2006) does not fully resemble the original source. Most definitions describe asepsis as achieving a state of freedom from all pathogenic micro-organisms (Hart 2007; Baillie 2014; Loveday et al. 2014; ASAP 2016). Pathogenic micro-organisms are those that are able to cause disease or infection (Nau Cornelissen et al. 2013; Carroll et al. 2016). The ability of a pathogen to cause disease will depend on the susceptibility of the host (the patient's condition) and the number and type of micro-organism (Nau Cornelissen et al. 2013) .

Achieving asepsis, freedom from any microbial contamination using an aseptic technique in ward settings is idealistic. In Klapes et al.'s study (1987) contamination rates of stainless steel strip (n=507), (emulating surgical instruments) aseptically removed from surgical test packs and transferred into 50ml bottles of trypticase soy broth were higher (2.7%) in a hospital environment (n=321) compared with 0.16% in a clean room environment (n=186) with laminar flow filters. The findings of Klapes et al.'s (1987) study show that even under very controlled conditions without any

detectable breaks in aseptic technique contamination can occur. From this it is inferred that asepsis is not an absolute concept. Tightly controlled conditions for aseptic technique are challenging to achieve in ward environments and impossible in domiciliary settings where nursing care is sometimes delivered.

Table 1. Different definitions of asepsis

Source	Definitions of asepsis
Xavier (1999)	is the prevention of microbial contamination of living tissue/fluid or sterile materials by excluding, removing or killing micro-organisms
Hart (2007)	the state of being free from living pathogenic micro-organisms
Fraise and Bradley (2009)	to prevent the transmission of micro-organisms to and from wounds from healthcare workers' hands and other susceptible sites thereby reducing the risk of infection/cross infection
RCN (2012)	is a process that seeks to prevent or reduce micro-organisms from entering a vulnerable body site such as a wound in surgery, an IV catheter, or during the insertion of invasive devices such as urinary catheters.
Baillie (2014)	absence of all living pathogenic micro-organisms
Loveday et al. (2014)	absence of potentially pathogenic microorganisms (Wilson 2006)
ASAP (2016)	freedom from pathogenic material in sufficient quantity to cause infection

2.2.2 Aseptic technique

Aseptic technique is the method used to achieve asepsis (Hart 2007). Aseptic technique has been variously described as a: method, procedure, practice and process (see Tables 2 & 3). There is a lack of clarity within the literature as to whether the aim of aseptic technique is to minimise or prevent contamination by micro-organisms into wounds or susceptible sites. Wounds are singled out in definitions and yet other susceptible sites are not identified. There is a difference between prevention and minimization. Minimization means to reduce to the least amount, whereas prevention means to stop contamination by micro-organisms. Authors writing about aseptic technique appear to be poorly-informed by seminal work such as the work of Klapes et al. (1987) as prevention is unlikely (see Section 2.2.1). Many definitions fail to recognise the need to protect health professionals or other patients from contamination (see Tables 2 & 3). Some definitions appear nebulous. There is no explanation of what is meant by 'controlled conditions' or

‘keeping the microbe count to an irreducible minimum’ (Crow 1989). These may be difficult for a health professional to conceptualise or measure when performing an aseptic technique. The infective dose is unknown and will vary. If definitions appear nebulous to qualified nurses, it is likely that nursing students will find them even harder to grasp.

Authors writing about aseptic technique are from a range of different backgrounds, including educators and infection control specialists (see Table 2). Few specialist infection prevention nurses have written about aseptic technique and published in nursing journals. There is an expectation that authors writing about aseptic technique would be experts, with specialist knowledge and provide accurate information. Some definitions of aseptic technique appear to be misreported, undermining the literature. For example, Ingram and Murdoch (2009) cite a definition by Flores (2008) (see Table 2) yet the origins of this definition could not be located. A definition by Crow (1997) is presented instead. Only a shortened version of this definition could be traced in Crow (1997 p93) “the purposeful prevention of the transfer of microbes “. The definition by Ingram and Murdoch (2009) resembles an abridged version of the RCN (2012) definition presented in Table 3.

2.2.2.1 When to apply aseptic technique

The indications for when to apply an aseptic technique varies across the literature (see Table 2). A more exhaustive list of clinical procedures that require an aseptic technique is provided by some (Preston 2005) more than others (Fraise and Bradley 2009). The application of aseptic technique during wound care is mostly commonly described. A stronger association of aseptic technique with wound care than other clinical procedures is recognised by Gilmour (1999). Nursing journals and textbooks tend to describe the steps of an aseptic technique procedure during wound care with varying complexity. For example, the number of steps of the procedure identified range from ten (Fraise and Bradley 2009) to twenty nine (Hart 2007) (see Table 2). At the time of conducting the study, the NMC (2010) essential skill cluster competency for aseptic technique in pre-registration programmes specified the safe performance of aseptic technique in wound care only (see Chapter 3). Subsequently, the Standards of proficiency for registered nurses (NMC 2018a) also only acknowledge the use of aseptic technique in the care and management of wounds. Other clinical procedures where nursing students might apply and be assessed in aseptic technique e.g. injection technique, are overlooked).

Table 2. Different definitions, indications and principles of aseptic technique from textbooks and journals

Source	Designation of author	Definitions	Indications	Principles/procedure
Xavier (1999)	Public Health Infection Control Nurse Specialist	A method used to prevent contamination of wounds & other susceptible sites by potentially pathogenic organisms	catheterisation, tracheal suction and wound dressing	Principles of asepsis - Use of sterile equipment and fluids, avoidance of direct contact with the susceptible site and other measures to reduce the risk of introducing pathogens into a susceptible site
Preston (2005)	Senior Nurse lecturer	aim to prevent the transmission of micro-organisms to wounds, or other susceptible sites, to reduce the risk of infection (Bree-Williams and Waterman 1996, Xavier 1999).	Wound dressings, urinary catheterisation, Injections, venepuncture & cannulation, care of central lines, blood glucose monitoring, eye drop administration, bladderwashouts/irrigation (adapted from Baillie 2005)	Refers to Gilmour (2000) procedural steps: sterile equipment, gloves and fluids and 'non touch' actions of the nurse. 13 step procedure adapted from Baillie (2005) which includes all of the above and the glove technique for arranging the sterile field
Wilson (2006)	Senior infection prevention nurse	To minimise the risk of introducing pathogenic micro-organisms into a wound or other susceptible site and to prevent transfer of pathogens from the wound to other patients & staff	Wound healing by primary intention,IV cannulation, urinary catheterization, suturing, vaginal examination during labour, medical invasive procedures	8 principles which are 6 procedural steps and 2 principles - 1) only sterile items come into contact with the susceptible site 2) sterile items do not come into contact with non-sterile objects

Table 2. Different definitions, indications and principles of aseptic technique from textbooks and journals (continued)

Source	Designation of author	Definitions	Indications	Principles/Procedure
Hart (2007)	Clinical Nurse Specialist in Infection control/ Radiation protection	A method employed to maintain asepsis & protect the patient from HCAIs.	Surgical aseptic technique used mainly in theatre for invasive procedures e.g. insertion of a central line & ANTT for less invasive procedures e.g. administration of IV drugs, wound care, urinary catheterisation, central line access and dressing changes, changing a wound drainage device	29 step procedure for ANTT procedure (1 person) which includes - prepare patient and equipment, handwashing, glove technique for arranging sterile field, sterile or non-sterile gloves as appropriate. no apron, new sterile pack if procedure interrupted for 30 mins.
Flores (2008)	Senior nurse, Infection control	The purposeful prevention of the transfer of organisms from one person to another by keeping the microbe count to an irreducible minimum (Crow 1997)	Urinary catheterisation, insertion and care of central line, IV feeding tubes and cannulation, wound dressings & other invasive procedures	No step by step procedure which involves hand decontamination, use of a sterile field, sterile gloves and sterile equipment (Crow 1997).
Docherty & McCallum (2009)	Director of /Senior lecturer of clinical skills	The process by which a nurse or healthcare professional aims to minimize the risk of introducing infection or contamination to a patient receiving care.	Catheterisation, IV cannulation, wound care, IV therapy, central lines, administration of chemotherapy, Use of Hickman line or portacath	17 step procedure which involves preparation of patient & trolley, use of forceps to arrange sterile field, sterile gloves & apron

Table 2. Different definitions, indications and principles of aseptic technique from textbooks and journals (continued)

Source	Designation of author	Definitions	Indications	Principles/Procedure
Aziz (2009)	Senior Infection Prevention and Control Nurse	1) A procedure undertaken with the aim of keeping the patient as free from hospital micro-organisms as possible. It is employed to prevent contamination of wounds and other susceptible sites by organisms that could cause infection (Mallett & Dougherty 2000) 2) To minimize the risk of introducing organism capable of causing an infection into a wound or susceptible site where micro-organisms would normally colonize or be expected. To prevent the transfer of organisms capable of causing an infection to other susceptible sites, service users or staff (Doughterty & Lister 2008) 3)To minimize the risk of introducing pathogenic organisms into a wound or other susceptible site and to prevent the transfer of pathogens from the wound to other patients or staff (Preston 2005)	Chilman & Thomas (1981) any procedure that may permit the entry of micro-organisms - catheterisation, bladder irrigation, venesection, IV infusion, lumbar and marrow puncture. Middleton (1983) every procedure that requires asepsis e.g. wound dressing, catheterisation or suturing a wound Dougherty & Lister (2008) surgical wounds, urinary catheterisation, suturing, coil fitting, IV cannulation, dressing IV lines & any other medical invasive procedure	Reviews 1.Chilman & Thomas (1981) Guidelines for aseptic technique -11 step 2 person 'no touch' procedure 2. Middleton (1983) Principles of aseptic technique - 2 person technique 4 point procedure - timing, preparation of the equipment, preparation of the patient & the technique ('no-touch') 3.Gilmour (2000) 14 step procedure - sterile equipment, gloves and fluid and non-touch actions of the nurse 4. Dougherty & Lister (2008) 14 step procedure - 1 person - sterile equipment, gloves & fluids, frequent handwashing
Fraise & Bradley (2009)	Consultant medical micro-biologist		used when there is a break in the skin integrity or when natural defence mechanisms are bypassed e.g. insertion of invasive devices	10 step aseptic & modified aseptic procedure Prepare patient & equipment, handwashing, apron & sterile gloves (if touching susceptible site, non-touch method difficult or procedure long & complex) non-sterile gloves (if no-touch technique used) sterile items not in contact with susceptible site or non-sterile items.

Table 2. Different definitions, indications and principles of aseptic technique from textbooks and journals(continued)

Source	Designation of author	Definitions	Indications	Principles/Procedure
Ingram & Murdoch (2009)	Senior practitioner clinical skills & Practice Developme nt Nurse	A set of specific practices & procedures performed under carefully controlled conditions with the goal of minimising contamination by preventing the transfer of pathogens from one person to another (Flores 2008)	Indications for use in IV therapy	7 principles of asepsis in intravenous therapy- Preparation of the environment, risk assessment, hand hygiene, personal protective equipment, equipment, patient preparation, safe technique
Dougherty & Lister (2011)	Assistant Chief Nurse & Nurse Consultant	is the practice of carrying out a procedure in such a way that you minimize the risk of introducing contamination into a vulnerable area or contaminating an invasive device	1) surgical joint replacement 2) urinary catheterisation 3) IV cannulation & refers to AT needed for changing a wound dressing	26 step procedure guideline for aseptic technique in wound care - Preparation of the equipment & patient, glove technique to arrange sterile field, sterile/non-sterile gloves & aprons
Baillie (2014)	Lecturer in Nursing	ensures that susceptible body sites (such as an open wound or insertion site for an invasive procedure) are not contaminated during procedures such as wound dressings, urethral catheterization or insertion of an intravenous cannula	Wound dressings, urethral catheterization or insertion of an intravenous cannula	Key principles - 26 step procedure Including the principle of avoiding contaminating sterile gloves or other sterile items
Dougherty & Lister (2015)	As above for Dougherty & Lister (2011)	As above for Dougherty & Lister (2011)	Used whenever carrying out a procedure that involves contact with a part of the body or an invasive device	As above for Dougherty & Lister (2011)

Table 3. Different definitions of aseptic technique from national policy and guidelines

Source	Definitions of aseptic technique
DoH (2003)	No definition
O'Grady (2011)	No definition
NICE (2012)	Aseptic technique ensures that only uncontaminated equipment and fluids come into contact with susceptible body sites. It should be used in a procedure that bypasses the body's natural defences. Using the principles of asepsis minimises the spread of organisms
RCN (2012)	Includes a set of specific actions or procedures performed under controlled conditions
Welsh Government (2014)	A healthcare procedure in which precautions may be taken to prevent exposing patients to micro-organisms. This can include the use of sterile gloves and equipment
Loveday et al (2014)	A set of specific practices and procedures used to assure asepsis and prevent the transfer of potentially pathogenic microorganisms to a susceptible site on the body (e.g. an open wound or insertion site for an invasive medical device) A carefully controlled procedure that aims to prevent contamination by micro-organisms
DoH (2014)	No definition
DoH (2015)	Used to describe clinical procedures that have been developed to prevent contamination of wounds and other susceptible sites
WHO (2015),WHO (2016a) WHO (2016b),	No definition
O'Neill (2016)	No definition

The definitions of 'aseptic technique' vary widely within the literature and are often ambiguous. Furthermore, few policy documents define aseptic technique. There is no universal definition of aseptic technique in textbooks, journal articles and policy documents (see Table 2 & 3). Each definition of aseptic technique was individually assessed and categorised to identify the most accurate definition to be applied throughout the thesis. A Delphi technique (McPherson et al. 2018), using an expert panel of seven individuals, consisting of infection prevention and control specialist nurses and nurse educators with expertise in infection prevention, was employed to reach consensus about an accurate definition of aseptic technique. The six criteria identified for assessing the accuracy of definitions listed in rank order of importance in Table 4 are derived from this work. A descriptor of the most and least accurate statements was produced for each criterion to ensure consistency and transparency in the assessment of definitions.

Table 4. Criteria for ranking the accuracy of definitions of aseptic technique

Criteria for definitions in rank order	**More accurate**	**Less accurate**
1. Liberal versus absolute concept	Minimise or reduce contamination/transfer	Free from or prevent contamination/transfer
2. Susceptible/vulnerable sites versus no susceptible/vulnerable sites	States 'susceptible' or 'vulnerable' sites	Does not state 'susceptible sites' or 'vulnerable sites'
3. Disease or infection causing micro-organisms versus non-disease or infection causing micro-organisms	Pathogenic micro-organisms/infection causing micro-organisms	Organisms or micro-organisms
4. Protect all individuals versus only patient(s)	Protects the patient, staff and other patients	Protects the patient (s) only
5. Range of susceptible sites identified versus limited or no susceptible sites recognised	More than one different type of susceptible/vulnerable site identified (wounds and others)	None or only one susceptible/vulnerable site identified
6. Any conditions/environment versus controlled conditions/environment	Does not specify under controlled conditions/environment	Specifies controlled conditions/environment

The criteria for assessing each definition is shown in Table 5. The number of criteria met by each definition was calculated. Two definitions, Wilson (2006) and

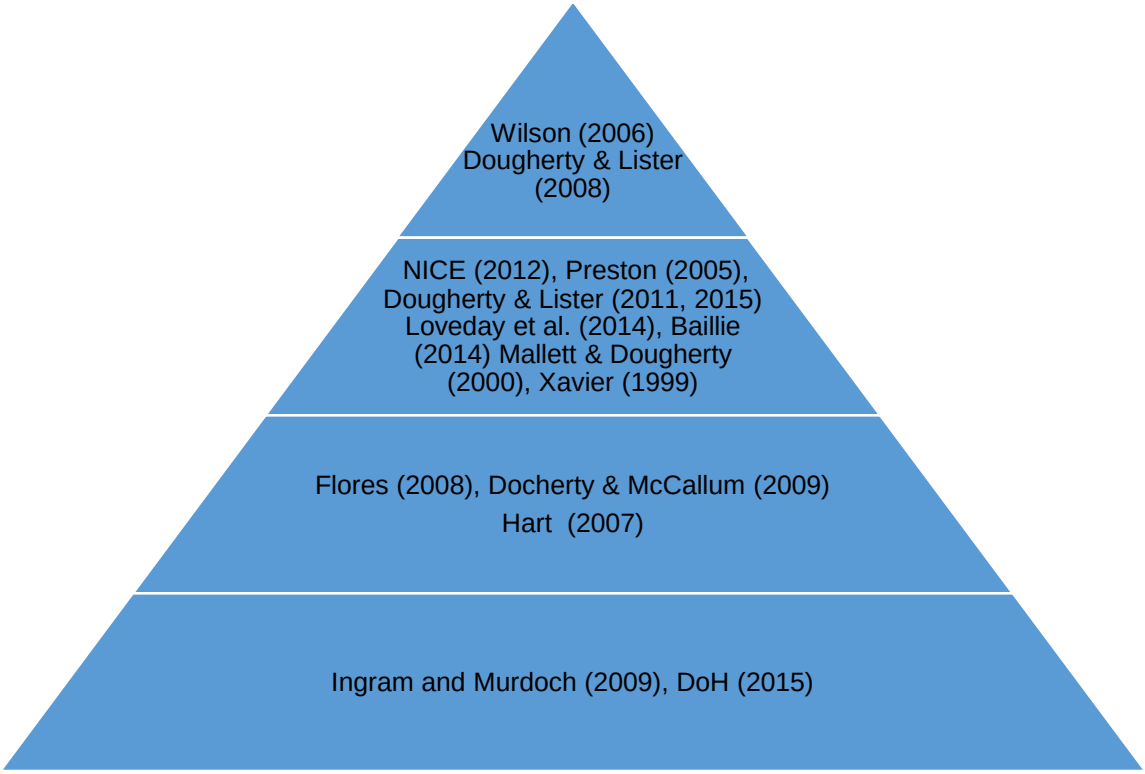
Dougherty and Lister (2008) met the most criteria, five out of the six essential criteria for accuracy.

Table 5. Assessment of definitions of aseptic technique

Essential criteria in rank order of importance	**Definitions**
1. Minimise or reduce contamination/transfer	Preston (2005), **Wilson (2006),** Flores (2008), **Dougherty & Lister (2008),** Docherty & McCallum (2009), Ingram and Murdoch (2009), Dougherty & Lister (2011), NICE (2012) Dougherty & Lister (2015)
2. States 'susceptible' or 'vulnerable' sites	Xavier (1999), Mallett & Dougherty (2000), Preston (2005), **Wilson (2006), Dougherty & Lister (2008)**, Dougherty & Lister (2011), NICE (2012) Baillie (2014) Loveday et al. (2014), Dougherty & Lister (2015), Department of Health (2015)
3. Pathogenic micro-organisms/infection causing micro-organisms	Xavier (1999), Mallett & Dougherty (2000), Hart (2007), **Dougherty & Lister (2008)**, **Wilson (2006),** Loveday et al. (2014)
4. Protects the patient, staff and other patients	**Wilson (2006) Dougherty & Lister (2008)**
5. More than one different type of susceptible/vulnerable site identified (e.g. wounds and invasive device)	Baillie (2014), Loveday et al. (2014)
6. Does not specify under controlled conditions/environment	Xavier (1999), Mallett & Dougherty (2000), Preston (2005), **Wilson (2006)** Hart (2007), Flores (2008), **Dougherty & Lister (2008)**, Docherty & McCallum (2009), Dougherty & Lister (2011), NICE (2012), Baillie (2014), Dougherty & Lister (2015)

A hierarchy of definitions was produced (see Figure 1), with definitions meeting the most criteria (five out of six) listed at the top of the pyramid and those meeting the least criteria (one) at the base of the pyramid.

Figure 1.Hierarchy of definitions of aseptic technique



Dougherty and Lister's (2008) definition of aseptic technique was comparable to that of Wilson's definition (2006). Both definitions recognise that all breaches in the body's natural defences place the individual at risk of infection and should be protected from contamination. The principles emerged from Lister's work with surgical wounds in operating theatres in the nineteenth century but have since been applied to other susceptible sites e.g. intravascular devices (Ayliffe and English 2003). The importance of preventing infection in staff as well as patients is acknowledged, setting these two definitions apart from the rest. A limitation of these definitions is that they do not specify when an aseptic technique should be applied. Wilson's (2006) definition of aseptic technique is more concise than that of Dougherty and Lister's (2008) definition. As stated earlier in Chapter 1, Wilsons' definition (2006, p.192) of aseptic technique was therefore chosen and will be applied throughout the thesis:

"To minimise the risk of introducing pathogenic micro-organisms into a wound or other susceptible site and to prevent transfer of pathogens from the wound to other patients or staff"

2.2.3 Aseptic non-touch technique (ANTT)

The term ‘ANTT’ and clinical practice framework were developed following a review of existing terms associated with aseptic technique (Rowley et al. 2010). ANTT was considered to be a more accurate and achievable term. There are fewer definitions of ANTT than aseptic technique in the literature (see Table 6). A plea for caution when explaining ANTT made by its originator may be responsible for fewer definitions of ANTT in the literature than aseptic technique (Rowley et al 2010). ANTT is defined as a type of aseptic technique with an exclusive theory and clinical practice framework (ASAP 2016). It is difficult to establish from this definition what exactly ANTT is, but implies an understanding of aseptic technique is required. ANTT is indicated for use in all invasive clinical procedures and the maintenance of medical devices in any setting (ASAP 2016). It appears to be an oversight that it refers to all medical devices rather than indwelling medical devices. ANTT does not recognise the terms ‘clean technique’ and ‘sterile technique’ (ASAP2016) in view of the microbiological definitions of ‘clean’ meaning free from marks and stains and ‘sterile’ free from all living and viable micro-organisms (see Section 2.5.5.1 and 2.5.5.3). Asepsis is the aim of ANTT as cleanliness is insufficient in preventing contamination of susceptible sites and sterility impossible to achieve in healthcare settings (Klapes et al. 1987). Some definitions attempt to interpret ANTT (see Table 6). In particular, the unique ANTT principle of protecting key parts and key sites (ASAP 2016), (see Section 2.6). For example, Dougherty and Lister (2015) refer to “not touching key elements” illustrating how concepts associated with aseptic technique may be changed by interpretation.

Table 6. Definitions of ANTT

Source	Definitions of ANTT
Flores (1987)	a specific method of applying aseptic technique
Hart (2007)	that when handling sterile equipment only the part of the equipment not in contact with the susceptible site is handled
Dougherty & Lister (2011) (2015)	the practice of avoiding contamination by not touching key elements (e.g. tip of a needle or inside surface of a sterile dressing)
Loveday et al. (2014)	a framework for aseptic technique based on the concept of defining key parts and key sites to be protected from contamination
ASAP (2016)	a specific type of aseptic technique with a unique theoretical and clinical practice framework

The effectiveness of ANTT compared to other approaches is unknown (see Section 1.7). No independent and robust research has been conducted to confirm a causal relationship between the implementation of ANTT and reduction of HCAI rates. The acceptability and practicality of ANTT compared to other approaches to aseptic technique is yet to be examined.Two evaluations of ANTT, using uncontrolled, pre and post-test designs have been undertaken by the creators of ANTT (Rowley and Clare 2009; Clare and Rowley 2018). An evaluation was undertaken in a convenience sample of seven acute trusts hospitals (Rowley and Clare 2009). Improved compliance and a reduction in bacteraemia were reported for: meticillin-resistant *Staphylococcus aureus* (MRSA) 57 to 15 (74%); meticillin-sensitive *Staphylococcus aureus* (MSSA) 92 to 68 (26%) and glycopeptide resistant enterocci 46 to 19 (59%) pre to post implementation (12 months). Another evaluation in two London Hospitals reported a reduction of MRSA bacteraemia from 41 to 15 cases in the NHS trust, 12 months pre and post implementation of ANTT (Clare and Rowley 2018). Statistically significant improvements were reported in compliance with the six core components of ANTT: glove use *(p=0.037)*, hand hygiene, Key-part protection, non-touch technique, Key-part cleaning and aseptic field management (*p≤0.001*) during intravenous therapy pre to post implementation at four years. There was a high risk of confounding factors. Due to the lack of control in the pre and post-test design any infection prevention interventions occurring at the same time as these evaluations might have impacted on infection rates. The need for more carefully controlled studies is recognised (Rowley and Clare 2009; Clare and Rowley 2018). ANTT has only been evaluated in intravenous therapy and cannulation and not in other invasive procedures such as wound care.

2.2.4 Clean technique

A clean technique is reported in the community when caring for chronic wounds (Hollinworth and Kingston 1998; Xavier 1999; Preston 2005; Aziz 2009; Unsworth 2011). The use of a clean technique is justified by the lack of controlled conditions and possibilities of disruption in the home environment (e.g. domestic pets) in chronic wounds which may be already contaminated. One nurse often dressing multiple wounds in the community increases the risk of cross-contamination (Unsworth and Collins 2011). There is no evidence available of the efficacy of a clean technique over aseptic technique (Aziz 2009). Most definitions of a clean technique (see Table 7) describe the technique as having the same aim as an aseptic technique. Fraise and Bradley (2009) refer to it as a ‘modified aseptic technique’. Definitions discuss the minutiae of the equipment required for a clean

technique (see Table 7). Some misreporting of information is evident in Preston's (2005) paper with regards to hand-washing which was traced back to Hollinworth and Kingston (1998). At the time of undertaking the study, the NMC Essential Skill clusters (2010) endorsed assessment of a clean technique and aseptic technique in pre-registration nursing students (see Chapter 3) which may have influenced learning. A clean technique is not a universally accepted practice or well supported by research evidence. The concept of a clean technique is not clearly delineated. In view of the hierarchy of decontamination and the definition of 'cleanliness' the concept of a clean technique might lead to confusion. The NMC (2018) no longer identifies the need for nursing students to be proficient in the use of a clean technique at the point of registration. The movement away from promoting the use of a clean technique through assessment is considered positive and in keeping with the hierarchy of decontamination.

Table 7. Definitions of clean technique

Source	Definitions of clean technique
Hollinworth & Kingston (1998) Xavier (1999)	adopts the same infection prevention principles to prevent the transmission of a pathogen but clean gloves, single use gloves and tap water may be used
Preston (2005)	has the same aims as an aseptic technique but uses clean instead of sterile gloves... and relies on less hand-washing (Gilmour 2000)
Wilson (2006)	to avoid the introduction of pathogens to a susceptible site and to prevent the transfer of pathogens to other patients or staff
Fraise & Bradley (2009)	the aim of modified aseptic (clean) technique/procedure is to prevent the transmission of micro-organisms to and from wounds, from healthcare workers' hands and other susceptible sites thereby reducing the risk of infection/cross infection
Baillie (2014)	non-sterile gloves, single use gloves and tap water for cleansing

2.2.5 Hierarchy of decontamination

An understanding of the hierarchy of decontamination and concepts of sterility, disinfection and cleanliness are necessary if the principles and safe practice of aseptic technique are to be understood. The hierarchy of decontamination has sterilization at the highest level, followed by disinfection and then cleaning at the

lowest level (Wilson 2006). The level of decontamination of equipment required is determined by the level of risk of causing or transmitting infection. Equipment which penetrates the skin and enters into deep areas of the body which are free of micro-organisms in health, such as internal body sites e.g. organs or fluids (blood or

cerebrospinal fluid) is considered high risk and requires sterilization (McDonnell and Sheard 2012). Sterilization can be achieved by physical methods such as heat by autoclave (moist heat) or hot air oven (dry heat), irradiation or chemical methods (e.g. ethylene oxide) (Wilson 2006). Autoclaving is considered to be the most reliable sterilization method, the higher the temperature of steam, the quicker the micro-organisms including spores will be destroyed. Hot air ovens require much higher temperatures for a longer period of time, up to one hour. Ethylene oxide is used by industry when equipment cannot withstand heat damage by autoclave or hot air oven. Lower temperatures are used in conjunction with ethylene oxide but the process takes days. Other chemicals are capable of sterilization but are less reliable (e.g. glutaraldehyde and peracetic acid) which require controlled conditions and greater exposure times (Wilson 2006).

Sterilization would be preferable but disinfection is acceptable in medium risk situations where items are in contact with mucous membranes or contaminated by easily transmitted micro-organisms. Disinfection can be achieved by pasteurization e.g. bedpan washers destroy many micro-organisms at temperatures between 65-80°C. Equipment used on intact skin is considered to be low risk in most situations and can be decontaminated by cleaning (Wilson 2006). Cleaning involves washing with hot water and detergent and drying. The terms sterility, disinfection and cleaning will be now defined.

2.5.5.1 Sterility

Sterile is defined as “free from all living or viable micro-organisms” (Bancroft 2013, p. 408) and sterility is the achievement of this state (Klapes et al. 1987). This definition infers that sterility is absolute; there is no in-between state. Sterilization is the process of eradicating and destroying all viable micro-organisms including spores (Bancroft 2013). Sterility can only be defined in terms of the probability of a micro-organism being present and the probability lowered rather than set to zero (International Standards Organization 2014). The term ‘sterilization’ might be often applied inappropriately but is achievable through a determined, repeatable and measurable process (Wilson 2006). The sterility assurance level (SAL) is “the

probability of a single viable micro-organism surviving after sterilization" (McDonnell and Sheard 2012, p. 294). A SAL of $10^{-6,}$ 1, in 1,000,000 probability of survival is commonly set for healthcare (McDonnell and Sheard 2012). A sterile device or product is often considered sterile up until the point of use, unless otherwise compromised. However, Klapes et al.'s (1987) findings suggest otherwise, that contamination can occur without breaches of aseptic technique under very controlled conditions.

2.5.5.2 Disinfection

Disinfection is defined as "any process whereby the potential of an item to cause infection is removed by reducing the number of micro-organisms present" (Hoffman et al. 2004, p. 1). Disinfection is described as unable to guarantee that all micro-organisms will be eliminated, but are reduced to a level that cannot instigate infection (Hoffman et al. 2004). Disinfection does not usually destroy spores (Wilson 2006). Whereas sterility is governed by strict quality control levels, disinfection is less reliable and more difficult to control. Disinfection and skin antisepsis are crucial for preventing HCAI during the insertion and management of intravascular devices (e.g. insertion site, hubs and ports (Loveday et al. 2014). The infective dose i.e. the number of micro-organisms necessary to cause infection varies between people and, within a person, depending on individual circumstances. Improper use of the terms 'disinfection' and 'sterilization' is common (Wilson 2006), an example being referring to the sterilization of baby bottles, when using a disinfectant which destroys some but not all micro-organisms.

2.5.5.3 Clean/Cleaning

The term 'clean' means 'free from dirt, marks or stains' (Oxford University Dictionary 2017). Cleanliness is the state or quality of being clean or being kept clean (Oxford University Dictionary 2017). Cleaning is the physical removal of organic material which may reduce the number of micro-organisms present and is necessary prior to the sterilization or disinfection of equipment (Wilson 2006; McDonnell and Sheard 2012). If equipment or a device is not cleaned or cannot be cleaned, sterilization cannot be achieved (McDonnell and Sheard 2012).

Cleaning skin and hands, equipment and environmental surfaces e.g. trolleys or trays are an important part of achieving asepsis (Hart 2007). Not all micro-organisms will be eliminated from environmental surfaces by cleaning or disinfection, with reduction in their numbers being transient (Loveday et al. 2014).

Preventing the transfer of micro-organisms from the environment to susceptible sites in patients is therefore reliant upon effective hand decontamination prior to patient contact (Loveday et al. 2014).

2.2.6 Use of the terms: sterility and cleanliness

There has been widespread confusion over the meaning of aseptic technique and how it can be achieved away from the controlled environment of the operating theatre (Gilmour 2000; Preston 2005; Aziz 2009). This might explain why different terms for aseptic technique mainly applied to wound care have evolved over time including: a Hampshire dressing technique (Broome 1973), sterile technique (Meers et al. 1992; Crow 1997), medical or surgical asepsis (Crow 1989; Ayliffe et al. 2000), clean technique (Crow 1997; Wilson 2006) and aseptic non-touch technique (Rowley 2001). Aseptic technique is the oldest term, in existence since Lister's work (Ayliffe and English 2003). The term 'aseptic technique' is not problematic; the issue lies with how it is understood and used by healthcare professionals.

Different terms associated with aseptic technique have been found to be used interchangeably in the literature. For example, the terms 'sterile technique' and 'aseptic technique' are used interchangeably by Xavier (1999). An electronic learning resource aimed at nursing students, refers to use of a: 'clean technique' 'sterile procedure', 'sterile technique' and 'aseptic technique' when discussing aseptic technique in wound care (Baillie 2014). Rowley et al. (2010) identifies a number of different terms to illustrate the confusion in terms associated with aseptic technique. The confusion in terms is used as the basis of the argument for introducing yet another term, ANTT to standardise the language of aseptic technique. However, some terms were found to be misreported by Rowley et al. (2010), for example 'non-touch technique' (DoH 2001b) and 'clean asepsis' (Ayliffe et al. 2000) which could not be located in the referenced sources. Authors appear responsible for proliferating confusion around different terms associated with aseptic technique. The literature is likely to cause confusion for both qualified nurses and nursing students.

2.3 Principles of aseptic technique

A principle is defined as a "rule or belief governing one's behaviour" (Oxford University Dictionary 2017). Principles of aseptic technique are rules applied when practising aseptic technique. Few papers have ventured to review the principles of aseptic technique (Briggs et al. 1996). A literature review by Briggs et al. (1996)

identified the fundamental principle of aseptic technique in wound care in protecting patients' wounds from micro-organisms from the nurse, environment (via airborne contamination) or patient. This principle originates from Lister's work in the nineteenth century (Ayliffe and English 2003). However, Briggs (1996) fails to draw upon Lister's work to support this important principle.

Nursing textbooks and professional journals identify numerous different principles (see Table 2). Authors and those that teach nursing students appear to place emphasis on different principles. Two different approaches to wound care dressings, aseptic technique and the wound field concept are reported to be taught to Australian nursing students (Gillespie and Fenwick 2009). The key principle of aseptic technique is that only sterile objects and fluid should come in contact with the wound. The wound field concept has one underlying principle that wounds are micro-environments and when exposed are not sterile (Gillespie and Fenwick 2009). This principle inaccurately infers that when wounds are covered they are sterile. The concept behind this principle is that all wounds contain micro-organisms but only exogenous micro-organisms from outside the wound can cause contamination.

The ANTT Clinical Practice Framework identifies four principles and four safeguards to guide teaching and practice of aseptic technique (ASAP 2016). The difference between safeguards and principles of ANTT is unclear. A safeguard is a measure taken to protect someone or something from harm (Oxford University Dictionary 2017). Identification of key parts of equipment (e.g. needle) and key sites (e.g. wounds or indwelling devices) is classified as a safeguard and protection of key parts and key sites from micro-organisms as a principle (ASAP 2016). The inability to clearly identify a principle has the potential to cause confusion.

The literature fails to accurately distinguish between professional standards, principles of aseptic technique and steps of aseptic procedures. For example, Bloomfield and Pegram (2010) identify respecting service user and their needs as a principle of aseptic technique rather than a professional standard. The principle that ANTT should be safe and efficient is a general principle of any clinical procedure (ASAP 2016). The principles of aseptic technique are often embedded within guidelines or descriptions of the steps of aseptic procedures and not clearly depicted (Wilson 2006; Baillie 2014; Dougherty and Lister 2015) (see Table 2). As a result, it is likely that nursing students as novices may have difficulty discerning the principles of aseptic technique.

Some principles are not well informed by evidence. One ANTT principle is to undertake a risk assessment to determine the technical difficulty of protecting key parts and key sites and whether surgical or standard ANTT is required (ASAP 2016). This suggests a move away from individual patient assessment towards an assessment based on the technical difficulty of the task, competence of the practitioner and environmental risks. The argument for this approach appears to be based upon the need to minimise the risk of airborne contamination (Rowley et al 2010), although the risk of microbial transmission by direct contact may be far greater (Ayliffe and Lowbury 1982; Gould 1991; Briggs et al. 1996).

There appears to be a lack of consensus within the literature of the principles of aseptic technique. However, the avoidance of contamination of susceptible sites is a unanimous principle supported by evidence. This may suggest that the principles of aseptic technique are not well understood, therefore influencing the practice of aseptic technique. The next section will explore qualified nurses' practice of aseptic technique.

2.4 Practice of aseptic technique

Aseptic technique, once a procedure undertaken by two clinicians working together is now mostly undertaken by a single clinician (Aziz 2009). Qualified nurses' aseptic technique practices have been reported to be variable and confused for many years (Bree-Williams and Waterman 1996; Hallett 2000; Rowley 2001; Preston 2005; Aziz 2009; Rowley et al. 2010; Rowley and Clare 2011; Unsworth 2011; Gould et al. 2017a). Variable and confused practice is inevitable if there is lack of clarity in the meaning of aseptic technique. Differences in where and how health professionals have been trained and lack of educational updates since training have been blamed for disparate practices across the UK (Bree-Williams and Waterman 1996; Aziz 2009; Unsworth 2011; Unsworth and Collins 2011; Gould et al. 2017a). Literature reviews and continuous professional development papers criticise aseptic technique practice for being ritualistic in the absence of evidence (Hollinworth and Kingston 1998; Aziz 2009).

A literature review by Briggs et al. (1996) recognised a dearth of research into qualified nurses' practice of aseptic technique compared to other infection prevention practices such as hand-hygiene. Two studies have explored ward based nurses' understanding and practice of aseptic technique (Bree-Williams and Waterman 1996; Gould et al. 2017a). Two studies have been conducted into

qualified nurses' practice of aseptic technique during wound care in the community (Hallett 2000; Unsworth and Collins 2011).

2.4.1 Ritualistic and complex practice

In Bree-Williams and Waterman's (1996) mixed methods study, ward based nurses' (n=21) aseptic technique during wound care was found to be complex and ritualistic. In sixteen out of seventeen observations of practice, nurses washed their hands more than twice. The transfer technique (clean forceps to transfer sterile material to the 'dirty' forceps) was maintained by three out of eight nurses. These findings may not be generalizable as the study was conducted in one hospital in the North of England, using a convenience sample of nurses. Selection bias may have affected the internal validity of the study as staff controlled researchers' access to observation of practice in the wards.

Earlier studies have found a simplified technique to be just as effective and microbiologically safe as more complex techniques (Thomlinson 1987; Kelso 1989). In Thomlinson's (1987) study, no difference was found in contamination rates between using forceps and gloved hands and ungloved hands washed in chlorhexidine when cleaning abdominal wounds. Forceps were awkward to use and did not prevent the transfer of infection from the wound to hands. In Kelso's (1989) study, a simplified aseptic technique (washing hands before and after the procedure and using one or two pairs of forceps without the transfer technique) was more cost effective, less time consuming, just as microbiologically safe than a more complex technique (using the transfer technique, five pairs of forceps and hand-washing three times). The simplified technique reduced the risk of airborne contamination by leaving the wound uncovered for a shorter period of time. More micro-organisms were isolated, the mean colony counts were higher on the finger streaks of both hands after loosening the dressing tape in lightly soiled dressings (70.7- 71.1) and moderately soiled (99.2-106.3) in the simplified technique than in the complex technique (15.2- 40.0) and (81.2- 87.9) respectively. Nevertheless, contamination of the forceps was reported to be similar in the simplified and complex technique. No data were presented to validate these findings.

The 'clean' hand, 'dirty' hand technique emerged following removal of forceps from wound dressing packs (Broome 1973; Alexander and O'Connor 1982). The 'clean' hand only comes into contact with the sterile field and the 'dirty' hand is used to clean the wound. Both hands should not come into contact with each other to avoid

contamination. Use of a ‘clean’ and ‘dirty’ hand has been criticised by Briggs et al. (1996) for lacking support from research evidence. Many other rituals have also been reported around the peripheral parts of aseptic procedures, such as cleaning the trolley (Briggs et al. 1996). In Thomson and Bullock’ study (1992) no benefit was found in cleaning the dressing trolley between patients unless visibly contaminated. The necessity for using a trolley in wound care has not been investigated (Briggs et al. 1996).

In conclusion, the complexity of aseptic procedures described in the literature varies (see Table 2). A simplified aseptic technique is not always promoted within the literature and practice guidelines. If nurses do not follow the available evidence, they may take unnecessary steps when performing aseptic technique.

2.4.2 Poor understanding of aseptic technique

The concept and principles of aseptic technique are not well understood by qualified nurses (Hallett 2000; Unsworth and Collins 2011; Gould et al. 2017a). A qualitative study by Hallett (2000) explored community nurses’ (n=7) perceptions of quality in nursing care using in-depth interviews. Community nurses did not fully explain the concept of aseptic technique and were uncertain about their ability to achieve aseptic technique in the domiciliary setting. These findings suggest a lack of understanding of how the principles of aseptic technique might be applied in the domiciliary setting. Hallett (2000) recommends the need to explore what is taught about aseptic technique in undergraduate education.

A qualitative study by Unsworth and Collins’ (2011) examined district nurses’ (n=10) adaptation of aseptic technique and adherence to the principles of asepsis using non-participant observation of aseptic procedures (n=30) and semi-structured interviews. In contrast to Hallett’s study (2000) district nurses believed they were able to perform aseptic technique in the community. In Unsworth and Collin’s (2011) study, nurses during interviews demonstrated understanding of the principles of aseptic technique and described adapting their practice to overcome challenges in the home environment. Despite this, nurses were observed contaminating the sterile field in twenty-one aseptic procedures. A lack of training and confusion over a clean technique and aseptic technique was identified.

A survey was undertaken to explore ward-based nurses’ (n=180) understanding of aseptic technique, confidence to perform aseptic technique and opportunities for educational updates and competency assessment (Gould et al. 2017a). Qualitative

content analysis of qualified nurses' responses revealed a lack of clarity about the meaning of aseptic technique. Aseptic technique was identified as a method or procedure by 65% (n=91) nurses. Confusion over the terms 'sterility' and 'cleanliness' was evident. Forty-six percent of nurses showed some understanding of aseptic technique in minimising or preventing infection. Only six respondents gave a more accurate description of the underlying principle of aseptic technique, based on Lister's work. The majority of nurses 92% (n=168) were very confident or confident in their ability to apply an aseptic technique, despite 72% (n=130) reporting not receiving any training in the last five years and 90% (n=164) no competency assessment since training. Eighty-nine percent (n=161) of nurses agreed that it was important or very important to standardise aseptic technique. Similar to Clare and Rowley's (2018) findings, 76% (37/49) of nurses strongly agreed that standardising practice improved patient care.

Studies into qualified nurses' understanding and practice of aseptic technique have emerged over a long period of time. In that time general opinion about HCAIs and the extent to which they are avoidable has changed immensely. Healthcare has changed, with increasing admissions and turnover of patients and use of more invasive procedures and devices. While the practice of aseptic procedures may change, the underlying principles remain the same. Only one study has comprehensively explored nurses' understanding of aseptic technique (Gould et al. 2017a). Most studies have been conducted using small samples of qualified nurses from one NHS Trust in the North of England (Bree-Williams and Waterman 1996; Hallett 2000; Unsworth and Collins 2011). Geographical variations in aseptic technique practices may exist.

2.5 Summary

It is challenging for anyone wanting to inform their aseptic technique practice using the literature. There have been many different contributors to the literature upon aseptic technique who have perpetuated rather than demystified the confusion around aseptic technique. No universal definition of aseptic technique exists. It is therefore difficult for health professionals to determine what they should aspire to achieve in terms of aseptic technique. Furthermore, how can aseptic technique be measured in a healthcare system where audit and measuring cost effectiveness is important. Nursing students may be faced with learning a concept which lacks clarity and being taught by qualified nurses who have sub-optimal understanding and practices. Confusion around aseptic technique might impact on the teaching

and assessment of students' competency in aseptic technique. The next chapter will present an overview of competency-based education and discuss how nursing students learn aseptic technique and are taught and assessed.

Chapter 3 - Aseptic technique in pre-registration nurse education

3.0 Introduction

There has been increasing emphasis upon competency based nurse education internationally (International Council of Nurses 2010; WHO 2013) This chapter will discuss competency-based education and the influence this might have upon the learning, teaching and assessment of aseptic technique in pre-registration nursing programmes. Pre-registration nursing programmes describe all programmes leading to entry to practice. In the UK, where this study has taken place, competency based education is well established (NMC 2010; NMC 2018b). Aseptic technique is identified as an essential skill in the curricula of pre-registration nursing programmes (NMC 2010; NMC 2018a). Nursing students are required to develop competency in aseptic technique. The NMC (2010; 2018a) is non-directive about when, what and how universities should teach and assess aseptic technique.

This chapter has three sections. The first section defines and discusses the strengths and limitations of competency-based nurse education. The second section discusses learning approaches and teaching methods used for aseptic technique in pre-registration programmes. The final section discusses the assessment of nursing students' competency in aseptic technique.

3.1 Competency-based nurse education

3.1.1 Definitions of competency-based education

Competency-based education is defined as "an outcomes based approach to the design, implementation, assessment and evaluation of ...education programs using an organizing framework of competencies" (Frank et al. 2010, p. 641). Anema (2009, p. 3) defines competency-based education as "assessments ensuring that graduates acquire the essential knowledge, skills and attitudes to enter the workforce". Both Anema's (2009) and Frank et al.'s (2010) definitions suggest competency-based education is more concerned with the assessment of learner performance and outcomes of learning rather than the process of learning (Pijl-Zieber et al. 2014).

3.1.2 Growth of competency-based education internationally

A competency-based approach to nurse education is politically driven by the need for cost-effective, efficient education and international mobility of the workforce (International Council of Nurses 2010). A competency-based approach to learning is increasingly being adopted internationally (International Council of Nurses 2010; Nursing and Midwifery Council 2010; College and Association of Registered Nurses of Alberta (CARNA) 2013; Kajander-Unkuri et al. 2013; Nursing and Midwifery Board of Australia 2013). It has been agreed that competency-based nurse education will be universally implemented and developed in countries where it currently does not exist (WHO 2013).

3.1.3 Benefits of competency-based nurse education

A systematic review by Tan et al. (2018) found competency based education improved nursing students' knowledge, skills and attitudes. However, it was recommended by Tan et al. (2018) that more robust experimental research including measuring patient outcomes was needed. The advantage of competency-based education is that it provides universities with clear guidance about the knowledge, skills and attitudes nursing students are expected to achieve by the end of their programmes, increasing accountability to the public (Chapman 1999; Cowan et al. 2005). Professional regulatory bodies such as the NMC formulate competencies, outlining the standards and requirements expected of a competent nurse and for accreditation of pre-registration programmes (Chapman 1999). Competency-based education ensures that nursing students achieve the same learning outcomes before they can progress in the programme or enter the register (Gravina Wascavage 2017). Competency-based education meets the needs of employers by producing graduates that require minimal further training and are well prepared for the workplace with flexible and transferrable skills (Chapman 1999).

3.1.4 Limitations of competency-based nurse education

There has been much criticism of competency-based education (Chapman 1999; Cowan et al. 2005; Tilley 2008; Pijl-Zieber et al. 2014). Competency-based approaches have been criticised for being too rigid and prescriptive, rather than learning focused (International Council of Nurses 2010). Competency-based education has been criticised for driving curriculum reform and dictating curriculum content (Chapman 1999). Confusion and debate about how competence and competency should be defined has undermined competency-based education

(Chapman 1999; Cowan et al. 2005). The measurement and assessment of competence has been recognised as fraught with difficulty (Watson et al. 2002; Pijl-Zieber et al. 2014). Competency-based education might encourage learners to meet minimum standards rather than strive for high quality standards (Watson et al. 2002; Cowan et al. 2005). In the UK, the Council of Deans for Health (2016) state that competency-based education stifles the innovation and creativity expected of universities in educating future nurses, which might influence education and training in aseptic technique.

Concerns have been raised that competency-based education is reductionist as it focuses on easily measured behavioural outcomes such as task orientated nursing procedures, overlooking the humanistic and caring aspects of nursing (Chapman 1999; Cowan et al. 2005). Competency-based education may encourage nursing students to be more focused upon learning the steps of aseptic technique in order to demonstrate competence at the expense of learning the underlying theory and principles (Cowan et al. 2005). Learning the steps of aseptic procedures may hamper nursing students' ability to apply the principles of asepsis in different clinical procedures and situations. Competence is defined by the NMC (2010) as acquiring knowledge, skills and attitudes that underpin safe and effective practice. Although the language used by the NMC (2018a) has changed from competencies to proficiencies, these are one of the same. Proficiencies are defined as the knowledge and skills registered nurses must demonstrate when caring for all people and in any care setting (NMC 2018a). The NMC (2010; 2018a) recognises that competence or proficiency is not purely about skill performance.

3.1.5 Effectiveness of competency-based nurse education

Undergraduate nursing programmes have been criticised for failing to develop students' competency in core skills such as assessment (McDonald et al. 2018); communication (Chant et al. 2002; Maclean et al. 2017) and recognition and management of deteriorating patients (Connell et al. 2016) instigating a review of nurse education in these areas. In Maclean et al.'s (2017) integrative review exploring the effectiveness of simulated patients in developing nursing students' communication skills, greater utilisation of simulated patients in a wider range of clinical situations and more rigorous studies was recommended. Similarly, an earlier literature review by Chant et al. (2002) reported a lack of robust research into the effectiveness of communication skills training in pre-registration programmes. In Connell et al.'s (2016) systematic review exploring the effectiveness of education in

the recognition and management of patient deterioration, educational interventions using medium to high fidelity simulation improved knowledge and skills. An integrative review by McDonald et al.'s (2018) investigating the effectiveness of e-learning in enhancing nursing students' knowledge and skills in nursing assessment found e-learning alone was not superior to face to face simulation. The findings of these reviews (Chant et al 2002; Connell et al 2016; Maclean et al. 2017; McDonald et al. 2018) suggest that competency-based nurse education may not be as effective in developing students' competency as desired. There is a need to scrutinise the teaching of core skills such as aseptic technique.

3.2 Learning and teaching of aseptic technique

Aseptic technique is an integral part of nursing curricula internationally (Nursing and Midwifery Council 2010; Nursing and Midwifery Board of Australia 2013; National Council of New Zealand 2014). Students may learn aseptic technique in university through face to face teaching and simulation (Mikkelsen et al. 2008; Gantt and Webb-Corbett 2010) e-learning (Chalmers and Straub 2006; Reime et al. 2008; Bloomfield et al. 2010; Pellowe et al. 2010) or a combination of both, referred to as blended learning (Karoglu et al. 2014). Rote versus meaningful learning of aseptic technique will be discussed first. Blended learning, simulation and e-learning will then be discussed in turn.

3.2.1 Rote versus meaningful learning of aseptic technique

Rote learning as opposed to meaningful learning may be influential upon nursing students' learning and understanding of aseptic technique. Ausubel's (1968) learning theory, derived from a constructivist paradigm, distinguishes between different types of learning using two dimensions, with one being a continuum of rote to meaningful learning. Meaningful learning is described as occurring if a task is learnt in a non-arbitrary and non-verbatim fashion related to what the learner already knows and the learner adopts an appropriate learning set, and has the disposition to learn in this way (Ausubel et al. 1978). In contrast, rote learning is the opposite: occurring if the task is learnt in an arbitrary and verbatim fashion, the learner lacks any relevant, prior knowledge and has the intention to learn in this way (Ausubel et al. 1978). Meaningful learning encourages deep learning, where new ideas and facts are critically examined and related to existing cognitive structures and links made between ideas (Quinn and Hughes 2013). In comparison, rote

learning promotes surface learning where new ideas and facts are accepted at face value and stored unconnected and in isolation of each other (Quinn and Hughes 2013). Meaningful learning is desirable for producing graduates with critical thinking skills and ability to make clinical decisions using evidence based practice (NMC 2010; NMC 2018a; Deane and Asselin 2015).

Meaningful learning compared to rote learning fosters a learner centred rather than a teacher centred approach where learners are actively engaged instead of passive in the learning process (Quinn and Hughes 2013). Meaningful learning develops problem solving by exploring arguments or key concepts which can be later applied to solve problems (Ausubel 1968; Mayer 2002). Concept learning is one type of meaningful learning identified by Ausubel (1968). Concepts defined as “objects, events, situations or properties that possess common criterial attributes” (Ausubel et al. 1978, p. 89). Concepts are universal, timeless and once understood, new knowledge can be transferred and applied in a variety of healthcare environments and situations (Deane and Asselin 2015). In comparison, rote learning relies upon formulaic learning, memorizing or recalling facts in a ‘cookbook fashion’, without understanding the principles and what one is doing, inhibiting the ability to problem solve (Ausubel 1968).

Meaningful learning leads to greater retention and transfer of learning than rote learning (Mayer 2002). An experimental study by Hilgard et al. (1953) tested meaningful and rote learning of card tricks in n=60 high school students and found retention and transfer of learning was superior in the meaningful learning group. The findings of this study using card tricks may not be transferable to the learning of a psychomotor skill such as aseptic technique. However, the findings suggest the need to explore the effect of rote learning compared to meaningful learning of aseptic technique upon retention and the ability to transfer learning in different clinical procedures and situations. Rote learning of aseptic technique may be detrimental to patient safety, resulting in nursing students’ failure to learn and apply the principles of aseptic technique in different clinical procedures and situations. Meaningful learning of aseptic technique requires a cultural shift in educators, away from teaching all aspects, including the minutiae of aseptic procedures to facilitating learning which may be more time consuming and resource intensive (Dalley et al. 2008; Deane and Asselin 2015).

Rote learning may encourage learners to view content as being learnt purely for assessment purposes. Students have been criticised for memorising the steps of

aseptic procedures to pass practical assessments (Davey 1997, Gonzalez and Sole 2014). Meaningful learning helps to make connections and relate new learning to previous learning, ensuring learning is built upon. Bruner (1960) refers to a spiral curriculum, whereby basic concepts or ideas are introduced and repeatedly revisited and built upon until they are fully understood by students. A spiral curriculum requires sequencing and linkage to be made between different sessions in an upwards spiral as the student progresses through the programme (Chambers et al. 2013). In contrast, rote learning may result in learning in different modules being viewed as separate entities, without recognition of how new learning builds upon previous knowledge (Quinn and Hughes 2013). Rote learning may fragment learning of aseptic technique if taught applied to different clinical procedures without connection in different modules throughout the programme. Meaningful learning links theory to practice (Quinn and Hughes 2013) which may help to address the theory practice gap in nurse education (Hatlevik 2011; Scully 2011; Ahmad et al. 2015) and aseptic technique (Cox et al. 2014).

3.2.2 Blended learning approaches

Blended learning is the use of face to face teaching combined with online learning methods (Karoglu et al. 2014). Blended learning offsets the disadvantages of single teaching methods and is student centred, providing flexible learning to meet a wide range of learner preferences (Kelly et al. 2009;Coyne et al. 2018). A systematic review evaluating the impact of online or blended learning versus face to face learning of clinical skills in undergraduate nurse education, found online learning to be just as effective as traditional teaching methods (McCutcheon et al. 2014). McCutcheon et al.'s (2014) review identified an inability to determine the effectiveness of blended learning of clinical skills due to a paucity of research studies. In Terry et al.'s study (2016), face to face teaching combined with the use of online resources was found to be no less effective than traditional teaching of infusion pump training in undergraduate nursing students. One of the limitations of the study is that the findings may not apply to older nursing students, as 89% of the sample were 34 years old or younger. However, the findings of Terry et al.'s (2016) might be transferable to teaching aseptic technique as preparing and setting up an intravenous infusion is a clinical skill requiring the use of aseptic technique. Blended learning, using simulation, and e-learning may be the optimal way of learning aseptic technique but is yet to be explored.

3.2.3 Definitions of simulation

Various definitions of simulation exist in the literature. A widely accepted definition of simulation is “an educational strategy in which a particular set of conditions are created or replicated to resemble authentic situations that are possible in real life” (International Nursing Association for Clinical Simulation and Learning 2016, p. S44). This definition though broad captures the essence of simulation in replicating real life situations. A concept analysis of simulation in undergraduate nurse education defined simulation as “a dynamic process involving the creation of a hypothetical opportunity that incorporates an authentic representation of reality, facilitates active student engagement and integrates the complexities of practical and theoretical learning with opportunity for repetition, evaluation and reflection” (Bland et al. 2011, p. 668). In contrast to other definitions, Bland et al.’s (2011) definition recognises the opportunities for learning the conditions required for effective learning e.g. active engagement of the learner. Billings and Halstead (2005 p.425) define simulation as “a near representation of an actual life event, which may be presented by using computer software, role play, case studies or games that represent reality and actively involve learners in applying the content of the lesson”. In comparison to other definitions, Billings and Halstead’s (2005) definition acknowledges the range and different modalities of simulation.

The different definitions of simulation may reflect how understanding and use of simulation has evolved in nurse education over time. All definitions describe simulation as emulating real life situations (Bland et al. 2011; International Nursing Association for Clinical Simulation and Learning 2016). Simulation is characterised by the active engagement of the learner (Billings and Halstead 2005; Bland et al. 2011). Simulation is described as an educational strategy or technique, helping students to apply theory to practice (Bland et al. 2011; International Nursing Association for Clinical Simulation and Learning 2016). Following review of the definitions of simulation in this thesis, Bland et al.’s (2011) definition was considered to be the best as it recognises the full potential of simulation in terms of nursing students’ learning. The use of simulation in nurse education and infection prevention education will be explored.

3.2.4 Use of Simulation

Simulation is increasingly being used as a learning strategy in the development and acquisition of clinical skills in pre-registration programmes in the UK and

internationally (Cant and Cooper 2010; Berragan 2011; Bland et al. 2011; Hope et al. 2011; Houghton et al. 2012; Norman 2012; Berragan 2013; Haraldseid et al. 2015; Ramm et al. 2015). At the time of conducting the study, the NMC (2010) endorsed the use of 300 hours of practice learning for simulation. The superseded NMC Standards for pre-registration nursing programmes (NMC 2018b) recognises the valuable contribution of simulation in students' learning but no longer provides guidance on the number of hours of simulation which are permissable. A longitudinal, randomized controlled study conducted in America by the National Council of State Boards of Nursing found that replacing 50% of clinical hours with simulation in pre-licensure nursing programs had comparable educational outcomes (Hayden et al. 2014). However, these findings should be viewed cautiously given the limitations of the study. While the students were randomized into study groups (replacing 10%, 25% and 50% of clinical hours) the ten Schools of Nursing involved in the study were not randomly selected. The chosen schools had a high interest in simulation and had more superior simulation facilities and equipment than other schools to be able to support the level of simulation used within the study. The findings of the study may therefore not be replicated elsewhere. There was also no blinding of preceptors or clinical instructors to the study groups students were assigned to, increasing the risk of measurement bias. The findings in relation to students' competency, critical thinking and readiness to practice might reflect those of more diligent students, as the study relied on students forwarding the survey to their preceptor. The limitation of Hayden et al.'s (2014) study and the belief that learning in practice is best, may account for the NMC (2018b) being more cautious about recommending a certain number of simulation hours. The increasing popularity of simulation can be attributed to reductions in placement provision, technological advances and safeguarding patients (Hope et al. 2011; Ricketts 2011).

Simulation is a valuable learning strategy for developing students' professional skills, building their confidence and bridging the theory practice gap (Leigh 2008; Robinson 2009; Hope et al. 2011; Ricketts 2011; Ricketts et al. 2012). Simulation allows students to learn and practice clinical skills, such as aseptic technique, in a safe environment that reflects the reality of practice situations (NMC 2010; NMC 2018b). Simulation allows students to develop a certain level of proficiency in aseptic technique before practising on patients, where poor technique could increase infection risk. An assumption is often made that knowledge and skills learnt in simulation can be directly transferred to clinical practice. Three systematic

reviews have found inconclusive evidence of the effectiveness of simulation in the transfer of learning into clinical practice (Cant and Cooper 2010; Harder 2010; Norman 2012). Students therefore may not be able to transfer knowledge and skills in aseptic technique developed through simulation into clinical placements. The next section will explore the effectiveness of simulation in infection prevention and control.

3.2.5 Students' experiences of learning in the simulated environment

Studies exploring students' experiences of learning clinical skills in the simulated environment report similar findings about the importance of creating a safe and authentic environment, availability and use of resources, motivating learning and building confidence (Hope et al. 2011; Houghton et al. 2012; Haraldseid et al. 2015). In the qualitative phase of Hope et al.'s (2011) mixed methods study, final year nursing students' (n=35) experiences of learning clinical skills through simulation were explored. Simulation was found to benefit students by providing a safe learnt environment in which they were able to familiarise themselves with equipment, develop confidence in practice procedures and integrate theory to practice. A limitation of Hope et al.'s (2011) study is that only students' perceptions of simulation were explored in one single university.

A qualitative, multiple case-study by Houghton et al. (2012) explored staff and students' (n=58) perceptions and experiences of teaching and assessment in the clinical skills laboratory. In Houghton et al.'s (2012) study, the clinical skills laboratory was perceived by students and staff as creating a pathway to practice, and the authenticity of the environment and links between the university and clinical setting being important for skill transfer. Staff and students identified that teaching could be improved by introducing scenarios and practising on real people rather than mannequins and providing video feedback on their performance of skills. A strength of Houghton et al.'s (2012) study compared to Hope et al.'s (2011) study is that both staff and students' experiences of simulation were explored across five case-study sites.

In Haraldseid et al.'s (2015) qualitative study of second year nursing students' (n=19) perceptions of learning in the clinical skills laboratory, three key factors were identified by students as influencing the learning of clinical skills: authenticity of the environment, motivation and resources. Concurring with Houghton et al.'s (2012) study findings, the authenticity of the environment and equipment in replicating

clinical practice was particularly important for students. Students perceived lack of time, equipment and opportunity to practice clinical skills and gain supervision and feedback upon their performance from teaching staff. The limitations of Haraldseid et al.'s (2015) study like Hope et al.'s (2011) study was that the findings from one nursing school may not be transferrable to other institutions. The findings of these earlier studies (Hope et al. 2011; Houghton et al. 2012; Haraldseid et al. 2015) support the need to explore factors that specifically influence learning of aseptic technique in the simulated environment.

3.2.6 Feedback upon performance in the simulated environment

Studies investigating the use of video feedback in the development of clinical skills have produced mixed findings. An evaluative study reported that both nursing students (n=77) and nurse educators (n=30) perceived video recording can enhance students' learning of interpersonal skills in clinical supervision (Minardi and Ritter 1999). Minardi and Ritter (1999) recognise that they have not directly asked whether video recording assisted or hindered learning of interpersonal skills to be able to make this inference. There was also a high risk of bias due to the use of a non-random sample of students who had agreed to undertake a course where video feedback of skills was an essential requirement. Using video feedback has been found to improve the accuracy of self-assessment in nursing and medical students (Yoo et al. 2009; Hawkins et al. 2012).

A quasi-experimental control group, pre and post-test study by Yoo et al. (2009) investigated the effects of video based self-assessment in second year nursing students (n=40). Students in both groups appeared to be similar in terms of competency at pre-test. Students in the video review group had significantly higher vital signs and communication skills performance scores at post-test than the control group (Yoo et al. 2009). These findings come from a small sample of nursing students in one university and may not be generalizable to other student populations.

In Hawkins et al.'s (2012) repeated measures study, medical students' (n=31) self-assessment scores for suturing, before video feedback, demonstrated moderate correlation with expert assessor scores, with no change after video feedback. Following video feedback with benchmark performance demonstration, self-assessment scores demonstrated a positive correlation with expert scores. Hawkins

et al.'s (2012) findings are based on one single skill in medical students and may not apply to other more complex clinical skills in other healthcare students.

However, an observational pilot study by Forbes et al. (2016a), found inconclusive evidence that video feedback enhanced verbal feedback upon final year nursing students' (n=8) detection and management of a simulated deteriorating patient. The generalisability of Forbes et al.'s (2016a) findings are limited by small sample size. A larger scale study is recommended. Video feedback has the potential to increase feedback upon student's performance of aseptic technique but should be used in conjunction with other methods of feedback.

3.2.7 Simulation and infection prevention and control

A few studies have explored the effectiveness of simulation for infection prevention and control education in nursing students and have produced mixed findings (Mikkelsen et al. 2008; Gantt and Webb-Corbett 2010). In Mikkelsen et al.'s (2008) study, simulation training in second year nursing students (n=21) was compared with scenario-based study groups with or without a teacher. Students (n=11) who received simulation training showed more awareness of the complexity of managing cross-infection scenarios than students (n=10) in scenario-based study groups. The risk of bias was high as the researcher was an educator in the university where the study took place.

In Gantt and Webb-Corbett's (2010) study, the patient safety behaviours of final year nursing students before and after instruction to improve hand-hygiene were compared. Randomly selected competency checklists (n=42/84) during a thirty-minute simulation were reviewed. Twenty-five percent of students were reported not to have correctly performed hand-hygiene. They either failed to wash their hands at the right time or had poor technique 45% of the time. This was compared with competency checklists (n=110) from another cohort of students that were given greater instruction. Forty-eight percent of students failed to perform hand-washing, and 38% of students missed one or more hand-washing opportunities. The findings are from two different cohorts and are reported differently making it impossible to compare. No raw data upon hand-hygiene errors or episodes were provided to validate these findings. In light of these limitations the findings of the study are not likely to be valid. Both studies explore different aspects of infection prevention education, making comparisons difficult (Mikkelsen et al. 2008; Gantt and Webb-

Corbett 2010). The impact upon hand-hygiene practices in clinical practice has not been explored. The next section will define e-learning.

3.2.8 Definitions of e-learning

E-learning has been defined as “a method which integrates information technology and the learning process by using material delivered through the internet to create, foster, deliver and facilitate learning anytime or anywhere” (Reime et al. 2008, p. 799). Other definitions similarly refer to online or mobile learning using information and communication technology (Voutilainen et al. 2017). The use of e-learning in nurse education will be explored in the following section.

3.2.9 Use of e-learning

The use of e-learning in nurse education is rising globally, particularly in Western countries such as the USA, UK and Australia (International Council of Nurses 2010; McKenzie and Murray 2010; Button et al. 2014). E-learning is used in learning clinical skills (Bloomfield and Jones 2013) and infection prevention (Chalmers and Straub 2006; Reime et al. 2008; Bloomfield et al. 2010; Pellowe et al. 2010).

The advantage of e-learning is that it allows students to learn flexibly, in their own time and pace and revisit learning (Feng et al. 2013). Greater quality and consistency in the content of instruction to larger groups of students can be achieved (International Council of Nurses 2010). This might improve the standard and consistency of teaching aseptic technique. A systematic review and meta-analysis provided inconclusive evidence that e-learning was more effective than conventional methods of learning in nurse education (Voutilainen et al. 2017).

3.2.10 Online video demonstrations

Online video demonstrations of clinical skills have been reported to be as effective as a real time demonstration (Kelly et al. 2009; Holland et al. 2013; Forbes et al. 2016b). In Kelly et al.’s (2009) quasi-experimental, post-test only control group study, no difference was found in students’ knowledge and skills between those who received online videos or a lecturer demonstration for clinical skills. Kelly et al.’s (2009) findings are not generalizable due to the small sample (14/204) and lack of power to detect statistical significant relationships.

A mixed methods cohort study by Holland et al. (2013) reported students receiving unlimited access to a medication administration video were significantly more

satisfied and likely to pass their assessment than those who received usual teaching (lectures and skills sessions). The response rate to the student satisfaction survey was low, particularly in the intervention group, 27% (71/266). The findings were based on two different cohorts of students without random selection in one single university and therefore might not be representative of students learning clinical skills in other universities.

A literature review has reported instructional videos to be equal to or more effective than face to face teaching in nursing students' learning of clinical skills (Forbes et al. 2016b). Videos allow students the opportunity to revisit key concepts (Kelly et al. 2009; Holland et al. 2013) and reduces the variability of demonstrations of clinical skills by multiple facilitators to large numbers of students (Corbally 2005; Chaung et al. 2018). The provision of both an online demonstration and real time demonstration of aseptic technique may be beneficial. The effectiveness of e-learning in infection prevention and control will be discussed in the subsequent section.

3.2.11 E-learning in infection prevention and control

Three studies have investigated the use of e-learning for infection prevention and control in nursing students (Reime et al. 2008; Bloomfield et al. 2010; Pellowe et al. 2010). A comparative study by Reime et al (2008) compared second year nursing students' (n=141) learning of infection control via e-learning (n=68) with lectures (n=73). Students who received lectures had statistically significant higher knowledge score than those who completed e-learning. Seventy percent of students were satisfied with learning via e-learning or lecture. A limitation of the study is that students were not randomly assigned to the different groups. An evaluation of an infection prevention e-learning programme in first year nursing students (n=282) was undertaken by Pellowe et al. (2010). Ninety-six percent of students (n=264) highly valued e-learning and 96% (n=272) reported being confident in their understanding of infection prevention. Ninety-seven percent (n=271) reported applying knowledge gained to practice (Pellowe et al. 2010).

A randomised controlled trial by Bloomfield et al (2010) compared the effectiveness of e-learning with face to face teaching upon first year nursing students' (n=231) hand-hygiene knowledge and skills. No significant differences were found in students' knowledge in the teaching (n=113) or e-learning (n=118) group at baseline

or follow-up. Students who received teaching had significantly higher skills scores than students who received e-learning group but only at 8-weeks follow-up. These findings should be viewed cautiously as 62% of participants were lost from the study at 8 weeks.

The impact of e-learning upon students' infection prevention and control practices in clinical practice has not been explored (Reime et al. 2008; Bloomfield et al. 2010; Pellowe et al. 2010). The heterogeneity of measurement tools used and studying students at different stages of their programme make the findings difficult to compare. The studies have been conducted at single sites by educators, increasing the risk of selection bias, limiting the generalizability of the findings.

3.3 Assessment of aseptic technique

3.3.1 Assessment of competency in infection prevention and control

Competency in infection prevention and control is an essential requirement for entry to practice internationally (Nursing and Midwifery Council 2010; Nursing and Midwifery Council 2018; CARNA 2013; Nursing and Midwifery Board of Australia 2013; National Council of New Zealand 2014; National Council of State Boards of Nursing 2014). While there are global standards for the initial education of nurses (WHO 2009,2016), there is no universal infection prevention and control curriculum or competencies for pre-registration programmes. There have been European and international attempts to identify core competencies for entry to practice (International Council of Nurses 2010). A systematic review identified eight broad competency areas for undergraduate nursing students in Europe which did not include infection prevention and control competencies (Kajander-Unkuri et al. 2013).

In the UK, infection prevention and control is one of five NMC essential skill clusters required to be integrated into all pre-registration programmes, applying to all fields of nursing (NMC 2010). The NMC (2010) essential skills clusters identify the infection prevention and control knowledge, skills and attitudes that nursing students are required to develop at different progression points of the programme. It is recommended that the NMC (2010) essential skill clusters are used to develop learning outcomes and practice assessment documents. The NMC essential skills clusters (NMC 2010) have since been replaced by the standards of proficiency for registered nurses (NMC 2018a). Proficiency in infection prevention and control is

addressed under one of the seven platforms for proficiencies required to be achieved at the point of registration, 'Promoting health and preventing ill-health' (NMC 2018a).

3.3.2 Assessment of competency in aseptic technique

Some countries with education standards or national competency standards for entry to practice do not identify a specific competency for aseptic technique (Australian Nursing and Midwifery Accreditation Standards 2012; CARNA 2013; Nursing and Midwifery Board of Australia 2013; National Council of New Zealand 2014). This does not provide conclusive evidence that nursing students' competency in aseptic technique is not assessed by universities in these countries. There is evidence to suggest that nursing students in Australia may have ANTT clinical competencies (Lewis 2009). However, the extent to which competency in aseptic technique is assessed internationally is difficult to establish. Improving infection prevention practices through assessment of aseptic technique is paramount in reducing the risks of HCAI and antimicrobial resistance globally (WHO 2016a; WHO 2016b) (see Chapter One). The development of a global competency for aseptic technique for nursing students would help to standardise and enhance practices across countries.

In the UK, there are explicit competencies (NMC 2010) or proficiencies (NMC 2018a) for the assessment of aseptic technique. At the time of collecting data, students were required to achieve the NMC Essential Skills Cluster: Infection prevention and control 25 competency; "People can trust a newly registered graduate nurse to safely apply the principles of asepsis when performing invasive procedures and be competent in aseptic technique in a variety of settings" (NMC 2010, p. 127). Nursing students were required to achieve six competencies: three by the second progression point (year two) and three for entry to the register (year three). The NMC Standards of proficiency (2018a) which replaced the NMC Essential Skill Cluster competencies (NMC 2010) identifies that nurses should demonstrate proficiency in aseptic technique by the point of registration. It is no longer a requirement to have assessment points at different stages of the programme.

The outcome of assessment of aseptic technique in pre-registration programmes may, in part, be affected by the timing and type of assessment. In Hunt et al.'s (2012) survey of practical assessment failure for nursing students in England, failure

rates for theoretical assessments exceeded practice assessments by 5:1, with students more likely to fail in year one than three. Hunt et al.'s (2012) findings indicate that students at the point of registration may be less likely to fail any competency or practical assessment of aseptic technique in clinical practice which would have implications for patient safety. The absence of an assessment or progression point for aseptic technique at the end of the second year (NMC 2018a) may mean that students' knowledge and skills in aseptic technique goes unchecked until the later stages of the programme, where failure is less likely (Hunt 2012). Patients may therefore be exposed to risk of infection if assessment is not robust.

The NMC is no less responsible than other authors for using different terms associated with aseptic technique interchangeably (see Chapter 2). The NMC Essential Skill competency statements change from nursing students achieving competency in the safe performance of clean and aseptic techniques in wound care by the second progression point, to a non-touch or aseptic technique upon entry to the register (NMC 2010). No differentiation is made between what a clean or aseptic technique is, and when they should be used. The NMC's (2010), endorsement of the use of both a clean technique and aseptic technique, disregards attempts to reduce confusion and standardise the language and practice of aseptic technique (Rowley 2001; Rowley et al. 2010) (see Chapter 2). Referring to the use of non-touch or aseptic technique infers these are separate techniques, as opposed to their being integral to each other. The standards of proficiency for registered nurses (NMC 2018a) which superseded the NMC Essential skill competency statements (NMC 2010) has since removed any reference to the use of a clean technique. However, there still remains a lack of consistency with regards to terms used when referring to the use of 'aseptic technique' and 'aseptic, non-touch technique' (NMC 2018). The NMC may be responsible for perpetuating confusion to a wide audience of nursing students and mentors.

The NMC (2010) Essential skill competencies make it clear that nursing students must be able to apply the principles of asepsis to invasive procedures, but only safe performance of aseptic technique in wound care is identified. This may reinforce the association of aseptic technique with wound care (see Chapter 2). Little appears to have changed as the standards of proficiency for registered nurses continue to refer to the use of aseptic technique in wound care only. This may result in nursing students failing to recognise the scope of aseptic technique and its application in other invasive procedures.

3.4 Summary

Aseptic technique is an integral part of pre-registration programmes internationally. Despite the dominance of competency-based programmes in nurse education, there are no universal competencies for infection prevention and control or aseptic technique. There is a risk that competency based education may promote surface and rote learning of the steps of aseptic procedures at the expense of deeper and more meaningful learning of the principles. There is a place for both, but a balance needs to be struck between learning the steps of aseptic procedures and underlying principles. While simulation and e-learning are widely used in nurse education, the effectiveness of these methods as part of blended learning of aseptic technique is unknown. Teaching/learning strategies need to achieve deep and meaningful learning of aseptic technique, in order for nurses to be able to apply the principles of aseptic technique in any clinical procedure or setting.

Confusion around the use of terms associated with aseptic technique in the NMC competencies and assessment of aseptic technique being confined to wound care persists, despite revision to the NMC Standards for pre-registration nurse education (NMC 2010, 2018a). If there is a lack of clarity in the NMC competencies for aseptic technique, it begs the question about what is being assessed about aseptic technique and in what clinical procedures. Teaching and assessment of aseptic technique in pre-registration nursing programmes needs to be robust, if infection practices are to be improved.

The next chapter will review the current research literature into nursing students' education, training and assessment in aseptic technique in undergraduate programmes.

Chapter 4 - Literature Review

4.0 Introduction

This chapter critically appraises the literature addressing nursing students' education, training and assessment in relation to aseptic technique. Chapter One has discussed national and international policy to reduce HCAI and the risks of antimicrobial resistance. Chapters Two and Three have demonstrated considerable confusion regarding what is meant by the term 'aseptic technique' which might influence what is taught and how competency is assessed in undergraduate nursing programmes. It is therefore important to investigate the core literature on nursing students' education, training and assessment in aseptic technique.

The literature review focuses on nursing students. A decision was taken to exclude medical students as they undertake invasive procedures such as central venous catheter insertion and lumbar puncture that are not taught during undergraduate nurse education. Studies which presented data for both nursing students and medical students were separated if possible but if not, each study was individually assessed during the screening process. All studies regardless of study design were included in the literature review in order to gain a full picture of research into nursing students' education, training and assessment in aseptic technique. This chapter presents the aims, methods, results and findings of the literature review.

4.1 Aim

The aim of the literature review was to answer the following research question: What are nursing students learning about aseptic technique?

Objectives were to:

1. Explore what undergraduate nursing students are taught and are learning about aseptic technique

2. Investigate how undergraduate nursing students are taught and assessed aseptic technique

3. Explore nursing students' knowledge and understanding of aseptic technique

4. Establish nursing students' competency levels in aseptic technique

4:2 Method

A three stage search strategy following Joanna Briggs Institute (JBI) methodology (Joanna Briggs Institute 2014) was undertaken. A decision was made to use JBI methodology (JBI 2014), as intervention studies were found to be in the minority, with the majority of studies using pre and post-test designs (See Section 4.3.1). These studies would therefore not meet the rigorous criteria used to evaluate clinical trials for a Cochrane Effective Practice and Organisation of Care (EPOC) review (2017). The JBI methodology (JBI 2014) was considered to be more structured than the Evidence-Informed and Policy and Practice (EPPI-centre) systematic review methodology which can be applied to all types of review questions and include all types of studies (Gough et al. 2017). JBI systematic review methodology had also been successfully used previously by the researcher (Edwards et al. 2011; Edwards et al. 2015).

The JBI methodology includes an initial investigative search prior to undertaking a targeted and systematic search (JBI 2014). An initial investigative search was advantageous in testing the search strategy to ensure that studies known to exist were picked up and no studies were unintentionally excluded. Stage one involves a preliminary search of MEDLINE and CINAHL; stage two a thorough search of all included databases using all keywords and index terms and stage three a review of the reference list of all identified papers.

Stage 1: An initial search of MEDLINE and CINAHL was conducted using keywords associated with the natural language terms of the topic. These databases were chosen as they followed JBI methodology (JBI 2014) and would retrieve any paper relevant to aseptic technique inclusive of educational papers. To scope the literature in this area, the initial search encompassed any paper related to aseptic technique and health professionals or healthcare students.

The keywords were:

1. Aseptic technique
2. ANTT (Aseptic Non-Touch Technique)
3. Health professionals or Healthcare student (nursing, medicine, dietetics, physiotherapy, radiography, dentistry and peri-operative practice)

4. Education

The preliminary search of the literature using the keywords for aseptic technique listed above, failed to identify some infection prevention and control studies with a focus upon aseptic technique known to exist e.g. Gould and Drey (2013) and Ward's studies (2010, 2011, 2012a, 2012b). Keywords for 'infection prevention and control' and 'healthcare-associated infection' were added to the next stage of the search to ensure that no relevant papers were excluded from the review.

Stage 2: The title, abstract and keywords of relevant articles were inspected and the controlled language index (MeSH) terms analysed to identify keywords for stage two. The key words and MeSH terms for aseptic technique, infection prevention and control, healthcare associated infection, nursing students, education, training, and assessment used can be found in Appendix 1. An extensive search of the published and unpublished literature was undertaken using the databases shown in Table 8 below.

Table 8. Databases searched

Databases
1. Cumulative Index to Nursing and Allied Health Literature (CINAHL)
2. Medline
3. British Nursing Index (BNI)
4. Scopus
5. Web of Science
6. Embase
7. Cochrane library
8. Educational Resources Information Center (ERIC)
9. Joanna Briggs Institute (JBI)
10. Health Management Information Consortium (HMIC)
11. Proquest Dissertations & Theses
12. Grey literature report
13. SIGLE (System for Information on Grey Literature in Europe)
14. Internet sites of relevant associations

Stage 3: The final stage of the search involved the following additional search strategies: searching the internet with a general browser (Google Scholar); screening reference lists of papers already retrieved; and hand searching key journals (American Journal of Infection Control, Journal of Advanced Nursing, Journal of Infection Control, Nurse Education Today) from 1996 onwards. The cut-

off point of 1996 was justified by the preliminary search confirming that the earliest study found about aseptic technique featuring nursing students was Davey (1997).

4.2.1 Inclusion and exclusion criteria

The search adopted the following inclusion criteria:

1. Education in aseptic technique (learning, teaching/training & assessment of aseptic technique in the university or clinical placement setting).
2. Nursing students
3. English language
4. Empirical papers (all types of research designs)
5. Published or unpublished papers from 1996 onwards

The following exclusion criteria applied:

1. Papers not in the English language
2. Papers that did not contain empirical data
3. Conference abstracts, news items and letters
4. Papers which had no outcome measures for aseptic technique

4.2.2 Screening process

Titles and abstracts of the identified papers were assessed to establish whether they met the inclusion criteria. The full text paper was retrieved for assessment if there was any doubt about whether the paper met the inclusion criteria. All potentially eligible papers were downloaded and scrutinised to ensure they met the inclusion criteria. The screening tool (see Appendix 1) used was developed especially for this study, based on a previous JBI systematic review exploring interventions to assist the transition from student to newly qualified nurse (Edwards et al. 2011; Edwards et al. 2015). After this, as part of the supervisory process, two reviewers independently reviewed all papers against the inclusion criteria.

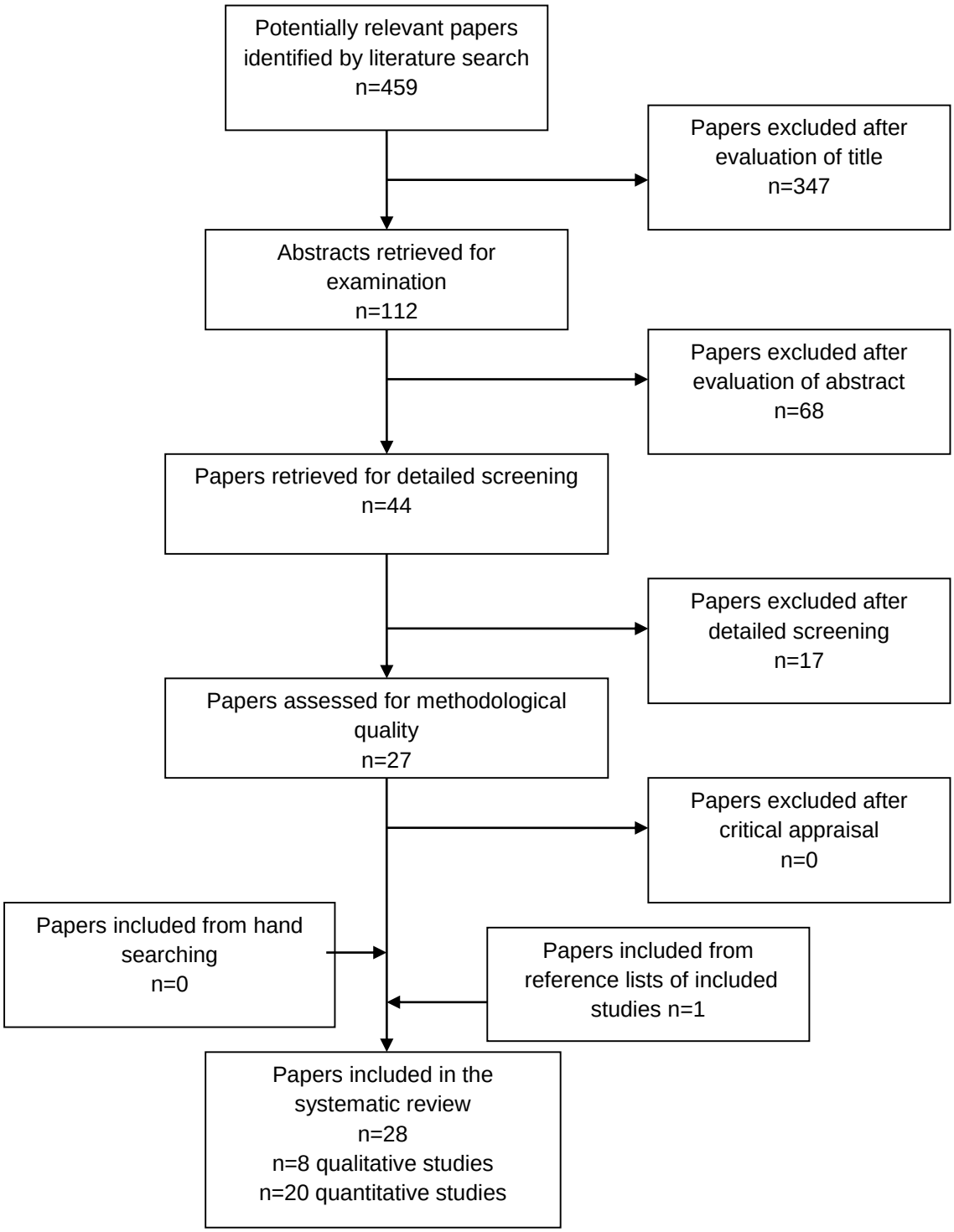
4.2.3 Critical appraisal and data extraction

Critical appraisal of intervention, cohort, and qualitative studies was undertaken using the Critical Appraisal Skills Programme (CASP) (2013) checklists. The CASP checklists were chosen as they cover most study designs that needed to be addressed. They have also been successfully used in infection prevention systematic reviews (Edwards et al. 2012). In the absence of a CASP checklist for surveys, Gerrish and Lacey's (2010) critical appraisal tool for surveys was used. The methodological quality of each paper was assessed and guided by three overarching questions within the critical appraisal tools: Are the results valid? What are the results? and Are they useful? No studies were excluded following critical appraisal on the basis of quality as all studies were found to be of low quality. Exclusion of studies on quality would have left no studies for review. Data relating to pre-registration students' learning, teaching, and assessment of aseptic technique were extracted under the headings (see tables 2 & 3 in Appendix 1) which were developed for the review.

4.3 Results

The database searches located 1006 papers (see Appendix 1). The selection process is summarised in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram below (see Figure 2). After examination, 547 duplicate papers were identified and removed. Following removal of duplicates, there were 459 papers for consideration and review. Of these, 347 papers were excluded as the title indicated that they did not fulfil the inclusion criteria. Following the review of abstracts, 68 papers were excluded as they did not meet the inclusion criteria of the review. After screening of the full text, 17 papers were excluded for not fulfilling the inclusion criteria. One paper was located from the reference list of a retrieved paper. A total of 28 papers were selected for critical appraisal and finally included within the review. A summary of the included studies will be provided in the next section.

Figure 2 PRISMA Flow Diagram



4.3.1 Summary of included studies

Twenty-eight studies were included in the review (see Figure 3). A summary of each paper can be found in Tables 2 & 3 in Appendix 1. The literature was organised into

qualitative and quantitative studies in accordance with JBI methodology (2014). There were eight qualitative studies and twenty quantitative studies. Quantitative studies were further split into interventional and observational studies resulting in three types of study: qualitative observational, quantitative intervention and quantitative observational studies. The quantitative research comprised of eight intervention studies and twelve observational studies. The studies came from a range of countries; the majority were from the UK (n=9) (see Appendix1). Most of the studies (n=20) were published from 2010 onwards, with a cluster of n=10 studies since 2014. Each study was categorised according to focus (see Table 9) and whether the findings reported, related to learning in university, clinical placements or both. The studies will be synthesized and discussed under these categories in the next section. The findings of Carter et al.'s (2017) study are not exclusive to one category and are reported under two categories. The majority of studies (n=16) reported all or some findings in relation to nursing students' experiences of learning aseptic technique in clinical placements (see Table 9).

Figure 3 Summary of included studies

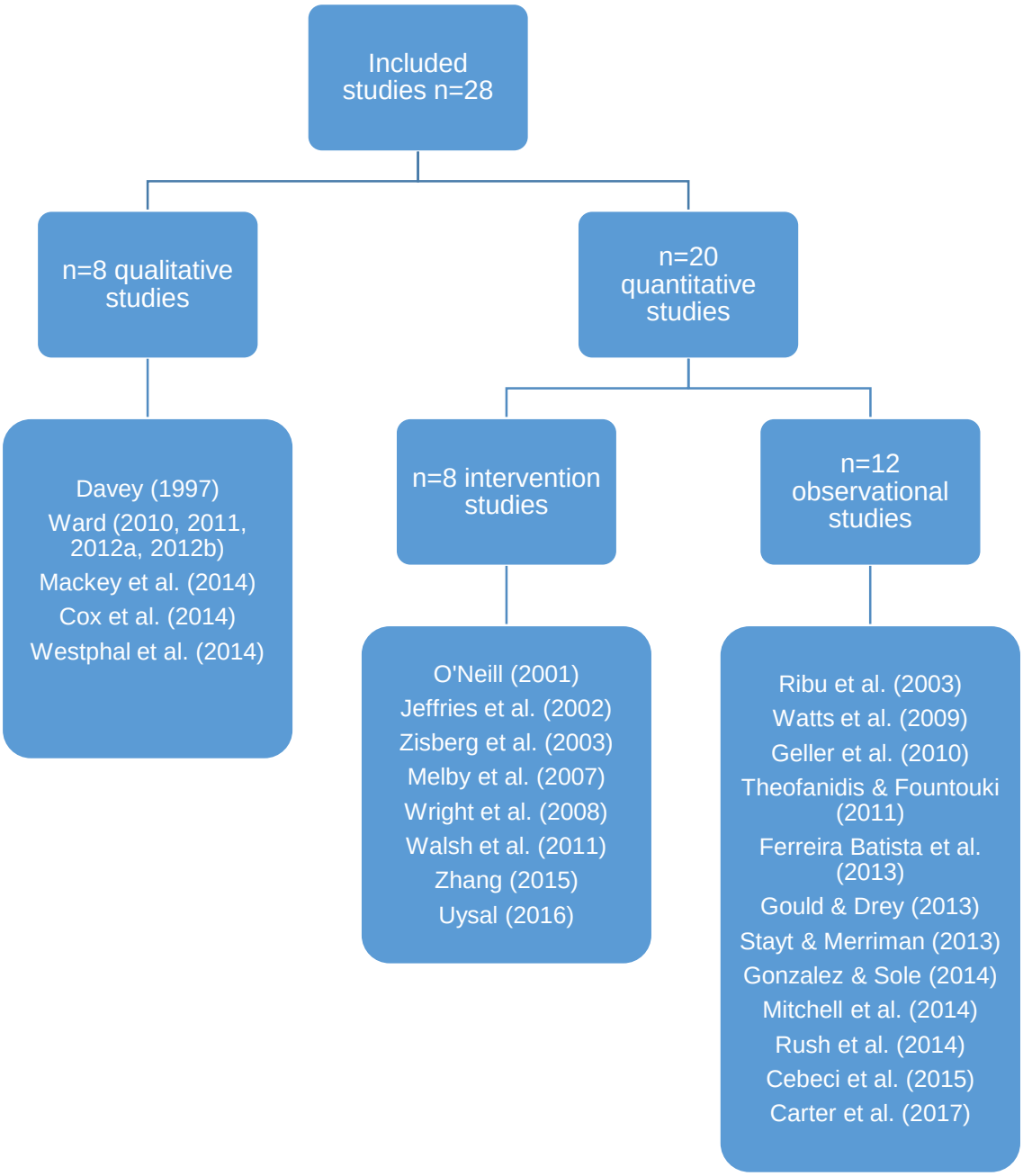


Table 9.Studies categorised by focus

Focus of the studies	Findings
1) The effectiveness of different teaching methods in learning aseptic technique **(n=10)**	**University (n=9)** O'Neill (2001) Jeffries et al. (2002) Melby et al. (2007) Wright et al (2008) Watts et al. (2009) Walsh et al. (2011) Theofanidis & Fountouki (2011) Mackey et al. (2014) Uysal (2016)
	Clinical placement (n=1) Zhang (2015)
2) Nursing students' knowledge, understanding and skills in aseptic technique **(n=8)**	**University (n=3)** Davey (1997) Gonzalez and Sole (2014) Rush et al. (2014) **Clinical placement (n=2)** Cebeci et al. (2015) Ferreira Batista et al. (2013) **University & Clinical placement** (**n=3)** Cox et al. (2014) Mitchell et al. (2014) Carter et al. (2017)
3) Students' experiences of learning aseptic technique in clinical placements **(n=11)**	**Clinical placement (n=11)** Ribu (2003) Zisberg et al. (2003) Geller et al. (2010) Ward (2010) Ward (2011) Ward (2012a) Ward (2012b) Stayt & Merriman (2013) Westphal et al. (2014) Gould & Drey (2013) Carter et al. (2017)

4.4 Findings

4.4.1 The effectiveness of different teaching methods in learning aseptic technique

Ten studies explored the effectiveness of different teaching methods related to learning aseptic technique (see Table 9): seven intervention studies, two observational studies and one qualitative study (see Tables 2 & 3 in Appendix 1). The studies came from seven different countries. Eight studies reported findings in relation to learning aseptic technique in university and one study to learning in clinical practice (see Table 9).

4.4.1.1 Intervention studies

The primary aim of six intervention studies was to compare the effectiveness of different teaching and learning methods in clinical skill development in university (Melby et al. 1997; O'Neill 2001; Jeffries et al. 2002; Wright et al. 2008; Walsh et al. 2011; Uysal 2016). There was no commonality of teaching approaches investigated across these university-based studies. Aseptic technique was applied in different clinical procedures: injection technique (Melby et al. 1997; Uysal 2016), dressing changes (O'Neill 2001; Jeffries et al. 2002; Wright et al. 2008) and urinary catheterisation (Walsh et al. 2011) making it difficult to make comparisons across studies.

Two intervention studies investigated different interventions when injection technique was taught (Melby et al. 1997; Uysal 2016). One randomised controlled trial found that nursing students (n=16) who did not receive a demonstration of intramuscular injection technique did not maintain asepsis (Melby et al. 1997). These findings need to be viewed cautiously given they were based on the review of one students' videotaped performance of aseptic technique from each group. A quasi-experimental, after-only non-equivalent control group design by Uysal (2016) evaluated the effect of scenario based practice upon reducing nursing students' mistakes in injection technique and intravenous access skills and nursing skills laboratory examination (NSLE) scores. A retrospective analysis of NSLE exam papers (n=605) found significantly higher scores, indicating better performance of injection technique and intravenous access skills for scenario than non-scenario based practice. The number of NSLE exam papers scores reviewed before scenario based training was introduced (n=60) was considerably less than those afterwards (n=545). No power calculation was reported to ensure that there was sufficient

power to detect a difference. Not following the principles of asepsis was the most common mistake for subcutaneous and intramuscular injections and intravenous access skills over a three-year period, despite the use of scenario based practice.

The effectiveness of different teaching methods for aseptic technique in wound care was explored in three intervention studies and produced mixed findings (O'Neill 2001; Jeffries et al. 2002; Wright et al. 2008). A quasi-experimental, pre-test post-test design compared traditional and interactive methods of teaching and found no significant differences in nursing students' (n=120) knowledge and skills in aseptic technique performance during a dressing change (Jeffries et al. 2002). The duration of laboratory practice as part of the intervention and potential for gaining practice outside of the intervention is unknown. Significant differences were found in satisfaction ($p<0.01$) but not self-efficacy or self-reliance in learning. The self-developed instruments used for measuring self-efficacy, self-reliance and knowledge demonstrated low to moderate internal consistency.

The effect of Physical, Environment, Task, Timing, Learning, Emotion & Perspective (PETTLEP) based imagery training was evaluated in n=56 nursing students' performance of aseptic technique during a dressing change and blood pressure measurement (Wright et al. 2008). No significant differences were found in aseptic technique performance between students who did or did not undertake imagery training. The sample size was small and no power calculation performed which was justified by the authors who labelled this a pilot study. There was no random assignment to the skill performed. The groups were uneven in size and it was unknown whether they were similar at baseline. The intervention took place over a four-week period, increasing the risk of contamination between groups and students gaining extra practice.

A quasi-experimental, pre and post-test design was used to examine the effects of stimulated recall (using critical analysis of videotaped performance) compared with memory recall alone in nursing students (n=43) (O'Neill 2001). Nursing students receiving stimulated recall demonstrated significant improvements in aseptic technique performance and greater accuracy in self-assessment than the control group. These findings should be viewed cautiously given that they are based on a small convenience sample and the experimental group was reported to undertake greater activity outside the intervention to improve their performance.

A randomised trial by Walsh et al. (2011) compared the effectiveness of expert assisted learning (EAL), peer-assisted learning (PAL) and computer assisted learning (CAL) upon nursing (n=25) and medical (n=35) students' female urinary catheterisation skills in the simulated environment. Breaks in aseptic technique were significantly reduced and performance scores significantly increased from pre to post-test but no significant differences were found between the EAL, PAL and CAL groups. However, performance was significantly higher in students who received EAL compared to PAL on skill transfer. The findings for nursing students are not reported separately and are based on a small convenience sample. The duration of the training session as part of the intervention is also unknown.

A quasi-experimental study by Zhang (2015), using an after only, non-equivalent control design, explored the effectiveness of standardized ward rounds compared to traditional ward rounds in preventing healthcare-associated infection. Nursing students (n=240) who received standardized ward rounds (n=120) had significantly higher knowledge and skills test scores for aseptic technique than those who received traditional ward rounds (n=120). There was a high risk of confounding which might have influenced the findings. For example, no direct measure of the impact on healthcare-associated infection rates was undertaken. Limited information was provided of the data collection methods, sample and intervention therefore it would be impossible to replicate the study.

4.4.1.2 Observational studies

The two observational studies identified were different in focus (Watts et al. 2009; Theofanidis and Fountouki 2011). An evaluative study compared nursing students' (n=86) self-assessment of videotaped skill performance in a sterile dressing change with faculty assessment (Watts et al. 2009). The number of breaks in aseptic technique identified by teaching staff was two to three times higher than those identified by students. Teaching staff identified the number of contamination incidents made by students as 54% (45/83) when setting up the sterile field and 34% (28/83) when cleaning the wound. There was no monitoring of learning activities and laboratory practice in and outside teaching time. An audit of male catheterisation teaching in one Greek nursing school was undertaken (Theofanidis and Fountouki 2011). Teaching of aseptic technique was found to be highly standardised with staff (n=4) rigidly adhering to the aseptic procedure described in a textbook. Other approaches to aseptic technique which could have been used whilst still adhering to the principles were not discussed. These findings may not be

generalisable to other schools of nursing because teaching practices, resources and facilities may be different.

4.4.1.3 Qualitative studies

One qualitative study, Mackey et al (2014) evaluated third year nursing students' (n=15) experiences playing the role of a simulated patient in a first year simulation. One of four main themes that arose was the ability to make comparisons between first year students' performance of aseptic technique as observed and their own level of skill. A sub-theme was 'criticisms', with third year students reporting concern about patient safety when observing first year nursing students breaching aseptic technique during a wound dressing. Only the third year nursing students' perspective is considered. There was no description of the university and participants: duration of the focus groups and member checking which undermines the credibility and rigour of the findings. The impact of this experience upon third year students' learning and practice of aseptic technique has not been established.

4.4.1.4 Summary

Assessing nursing students' ability to undertake aseptic technique was not the primary aim of any of these studies. The heterogeneity of interventions and use of different measurement tools made it difficult to compare outcomes across intervention studies (see data extraction Tables 1 & 2 in Appendix 1). Nursing students in the first and second year of study were mostly studied. The impact of university based interventions upon aseptic technique practices in clinical practice is unknown.

Intervention studies were of low quality, single site studies, using small convenience samples of students. No power calculations were performed to estimate sample size. The risk of selection and measurement bias and contamination between groups was high in intervention studies due to poor or lack of randomisation and/or blinding. There was a lack of control of confounding factors such as engaging in extra practice or activities outside of interventions. The duration of interventions was often unclear and therefore could not be replicated. The reliability of some measurement tools was poor (Jeffries et al. 2002) and validity and reliability of others unknown (Zhang 2015). There was limited evidence of the effectiveness of teaching/learning interventions in clinical practice (Zhang 2015).

Observational studies were small, single site studies (see Tables 1 & 2 in Appendix 1). The validity of checklists/audit tools and inter-rater reliability of assessors were not reported. There was a high risk of measurement bias in Watts et al.'s (2009) study. One single qualitative study was found (Mackey et al. 2014), which did not provide enough detail of the sample and data collection process, affecting the rigour and credibility of the study.

4.4.2 Nursing students' knowledge, understanding and skills in aseptic technique

Eight studies explored nursing students' knowledge, understanding and skill in aseptic technique (see Table 9). The studies came from five different countries (see Tables 2 & 3 in Appendix 1). They consisted of six observational studies and two qualitative studies. Three studies reported findings in relation to nursing students' knowledge and skills in aseptic technique in the university setting (see Table 9 & Appendix 1). Two studies reported findings in nursing students' use of aseptic technique knowledge and skills in clinical placements. Three studies reported findings in the development and/or use of knowledge and skills in aseptic technique in university and clinical placements.

4.4.2.1 Observational studies

Of the six observational studies, two studies examined nursing students' skill level in aseptic technique in the simulated environment (Gonzalez and Sole 2014; Rush et al. 2014) and one study in clinical practice (Cebeci et al. 2015). Three studies focused on nursing students' knowledge and intention or confidence to apply aseptic technique in clinical practice (Ferreira Batista et al. 2013; Mitchell et al. 2014; Carter et al. 2017).

Of the three studies that explored nursing students' skill level, two studies attempted to examine nursing students' errors in aseptic technique (Gonzalez and Sole 2014; Cebeci et al. 2015). A descriptive, pilot study assessed nursing students' (n=13) competency in urinary catheterisation in the simulated environment to identify the most common breaks in aseptic technique made by students (Gonzalez and Sole 2014). Students' confidence levels ranged from 3-5 with mean rating of 3.6 on a 5-point scale. Seventy-seven percent (10/13) of students were reported breaking aseptic technique in at least one category and in some cases several categories. No raw data is provided to establish the number of breaches of aseptic technique for each category. Instead the number of students performing the correct steps in

opening and assembling the catheter kit (54%), applying sterile gloves (62%) and cleaning the uretheral meatus (38%) is reported. The challenges faced by students in donning gloves, preparing and maintaining the sterile field are only described. The most common breach of aseptic technique reported in the abstract only, occurred when cleaning the urethral meatus and was made by seven students (54%). The percentages reported are misleading given the small sample size. There is no description or assurance about the reliability of the standardised checklist used to assess competency. The number of students breaching aseptic technique was high given that these students had previously demonstrated competency and over a third were employed in a hospital where aseptic technique would be practised. The type of breaches in aseptic technique are similar to those made by nursing students during a dressing change in Watts et al.'s (2009) study, discussed previously (see section 3.3.1.2). These findings suggest that students lacked self-awareness, being confident about performing the skill, despite demonstrating poor competency in simulation.

A cross-sectional study by Cebeci et al. (2015) investigated nursing students' (n=324) intravenous fluid administration errors in clinical practice. Deviations from aseptic technique accounted for the highest number of errors 23.8% (96/420) reported by students. This is much lower than in Gonzalez and Sole's (2014) study but the studies are not comparable in size. Students attributed the most common cause of their medication errors to performance 43.4% (141/324) and knowledge 41.0% (133/324) deficits. The differences in awareness and assessment of errors between students and academics, measurement tools and the practice environment make Gonzalez and Sole's (2014) and Cebeci et al.'s (2015) findings difficult to compare. It is unclear from these studies, the students' year of study.

An evaluative study by Rush et al. (2014) explored first year nursing students' (n=180) perceptions of objective structured clinical assessments (OSCAs). A high pass rate of 89.4% (n=161) was reported for the aseptic technique OSCA at first attempt, suggesting competency in aseptic technique. However, this figure reflects only the pass rate of students that responded to the survey and not the entire cohort (n=272). Non-responding students may have had a lower pass rate on first attempt. It is difficult to compare these findings to Gonzalez and Sole's (2014) and Cebeci et al.'s (2014) study or Wright et al.'s (2008) study discussed previously, as OSCE scores rather than pass rates were reported. There was also insufficient detail of the

sample, OSCE stations for aseptic technique and assessment tools to be able to make comparisons.

Three observational studies investigated nursing students' knowledge and intention or confidence to apply aseptic technique in clinical practice (Ferreira Batista et al. 2013; Mitchell et al. 2014; Carter et al. 2017). An exploratory survey examined nursing students' (n=30) understanding of infection prevention in ventilated patients in the intensive care setting including the use of aseptic technique (Ferreira Batista et al. 2013). Twenty-three percent of students (10/30) identified the use of aseptic technique as a strategy for preventing healthcare associated infection in mechanically ventilated patients with multi-drug resistant bacteria. The percentages reported by Ferreira Batista et al. (2013) are inaccurate. Furthermore, they are misleading as they are based on a very small convenience sample of students. In Mitchell et al.'s (2014) cross-sectional survey of final year nursing students' (n=349) knowledge and intentions towards infection prevention practices from six universities, 60% of students strongly agreed an aseptic technique was required when caring for intravascular devices. These findings might not reflect students' actual practices. The response rate to the survey was low (21%) and therefore the findings might not be generalizable.

A national online survey conducted by Carter et al. (2017) explored the relationship between time spent in infection prevention education and nursing students' (n=3678) knowledge, attitudes and practices of aseptic technique. It was reported that nearly 99% of students agreed that they understood the meaning of aseptic technique and it was necessary to prevent infections during the placement and maintenance of invasive devices. The exact figure is not reported but is much higher than that of smaller studies Ferreira Baptista et al.'s study (2013) and Mitchell et al.'s study (2014). No definition of aseptic technique is provided to establish the accepted meaning of aseptic technique.

Twelve percent of students reported not being confident in their ability to insert and maintain invasive devices using aseptic technique. Sixteen percent reported difficulty in applying aseptic technique when inserting or maintaining invasive devices when busy. These figures suggest that students were confident about applying aseptic technique in clinical practice. Students who received aseptic technique training in simulation or clinical practice were more confident in their ability to insert and maintain invasive devices than those who reported lectures

(p=0.003). This is similar to Gonzalez and Sole's (2014) findings in the simulated environment where students perceived their confidence as good to high.

In Carter et al.'s study (2017) a similar percentage of students reported receiving one to three hours (32%) and four to eight hours (34%) of aseptic technique education. A wide range of time was spent in aseptic technique education. The majority of students, 63%, reported receiving education through simulation compared to lectures 21% and 15% in clinical practice. Eighty-nine percent of students reported agreement between what was taught in schools and observed in practice. A significant association was found between hours of aseptic education and respondents reporting difficulty with infection prevention practices including aseptic technique when busy ($p<0.0001$). These findings should be viewed cautiously given the low response rate (7%) to the survey. Sampling bias was an issue with only nursing students with membership of the National Student Nurses' Association included within the survey. The use of self-reported methods relied on accurate recall of time and location of education by students.

4.4.2.2 Qualitative studies

Two qualitative studies explored nursing students' knowledge and understanding of aseptic technique from different perspectives A qualitative study by Davey (1997), examined second year nursing students' (n=18) knowledge and understanding of aseptic technique in the clinical skills laboratory using in-depth interviews and a written exercise. Students failed to demonstrate a full understanding of aseptic technique. No student was able to identify all eleven of Kozier et al.'s (1991) principles of aseptic technique, given as pre-reading. Seven students could not identify any principles. These findings need to be viewed cautiously as following review of Kozier et al.'s (1991) book, only nine principles rather than eleven were stated. Students had a greater knowledge and understanding of the aim or procedure of undertaking an aseptic technique than the principles of aseptic technique. There was insufficient detail of the research setting, study methodology and educational provision in aseptic technique to determine the transferability of these findings obtained under simulation to other universities and to the clinical setting.

A qualitative study by Cox et al (2014) explored infection control professionals' (n=8) perceptions of infection control training in undergraduate programmes and the transferability of knowledge to clinical practice. Using semi-structured interviews,

four main themes emerged. The first theme, ‘theory versus practice’ recognised deficits in new graduates’ infection control knowledge and existence of a theory practice gap in aseptic technique. A lack of understanding of the importance of infection control was considered to be a potential reason for difficulties in transferring theory to practice. The second theme, ‘the importance of role modelling’ was about the strong influence of peers and senior staff as role models for infection control practices. Disconnect between university curricula and the ’real world’ was the third theme. Infection control professionals perceived a difference between what is taught in universities and practised although they were unaware of what was taught in universities. This is in contrast with students’ perceptions in Carter et al.’s (2017) study, where 89% of students reported parity between what was taught in universities and practised. The fourth theme was ‘learning in context’ reflecting the view that graduates’ infection control knowledge and practices could be improved by learning in a clinical context. The strength of the study was that the infection control professionals came from a range of hospitals, in three Australian states. A limitation was that an educators’ perspective was not gained which might have provided a different perspective.

4.4.2.3 Summary

The findings of the studies suggest that nursing students’ knowledge, understanding and competency in aseptic technique may be sub-optimal. Studies with the primary aim of exploring nursing students’ knowledge, understanding and skill in aseptic technique were sparse. No study has explored educators’ and infection control professionals’ understanding of aseptic technique.

Many observational studies were conducted on single sites using small non-probability samples increasing the risk of selection bias. There was heavy reliance upon self-reported knowledge and skills by students. Comparing nursing students’ knowledge, understanding and skill at the same stage of programmes across studies was difficult. Poor reporting was evident in both observational and qualitative studies.

4.4.3 Nursing students’ experiences of learning aseptic technique in clinical placements

Eleven studies focused on nursing students’ experiences of learning aseptic technique in clinical placements (see Table 9). The studies originated from four countries, with the majority of studies (n=6) from the UK (see Tables 2 & 3 in

Appendix 1). Six were quantitative studies and five qualitative studies. Of the six quantitative studies, there was one intervention study and five observational studies.

4.4.3.1 Intervention studies

A quasi-experimental, within-subject design by Zisberg et al. (2003) explored the effects of nursing students' presence upon the quality of care provided by nurses (n=67). Qualified nurses were found to provide higher quality care and have higher aseptic technique scores in the presence of nursing students than without. These findings suggest that health professionals may raise their standard of aseptic technique practice in the presence of students. These findings should be viewed cautiously as the hypothesis of the study might have been suspected by the nurses, as they were observed providing care with and without students within a short time period. The presence of students might be operating as an observer effect.

4.4.3.2 Observational studies

Five observational studies explored nursing students' experience of learning aseptic technique in clinical placements (see Table 2 in Appendix 1). Of these, three studies specifically explored nursing students' experience of infection control practices in clinical placements (Geller et al. 2010; Gould and Drey 2013; Carter et al. 2017) (see Tables 2 & 3 in Appendix 1).

Nursing students reported observing poor aseptic technique (Ribu et al. 2003; Geller et al. 2010; Gould and Drey 2013; Carter et al. 2017). In Ribu et al.'s (2003) descriptive, observational study of community nurses' (n=31) leg and foot ulcer care, nursing students observed 60% (21) of nurses washing their hands before and after ulcer treatment. Poor aseptic technique practices were reported, with nurses demonstrating inappropriate use of gloves (n=7), wearing hand jewellery (n=3), compromising the aseptic field with dirty linen or loose hair (n=2). Nurses were aware of being observed by students, but contrary to the Hawthorne effect (Franke and Kaul 1978) the findings suggest that this did not enhance their performance of aseptic technique in response. Only the students' perspective of aseptic technique practice was gained.

A retrospective data analysis of infection control practices and near misses reported over a three period by nursing students (n=500) was undertaken by Geller et al. (2010). Of the infection control hazards and near misses reported (n=886), 17.2% (152/886) were breaks in aseptic technique. Nursing students in this university were

trained to report infection control hazards. There was a risk of reporting bias due to over or underestimation of hazards or near misses by students. In an online survey, nursing students (n=488) were highly critical of doctors' and nurses' aseptic technique practices, particularly nurses working in the community or long stay elderly facilities (Gould and Drey 2013). Only nursing students with Royal College of Nursing membership were included in the survey introducing sampling bias.

In Carter et al.'s (2017) study, (described earlier in section 4.4.2.1) 51% of students reported observing poor infection prevention and control practices including aseptic technique in clinical placements. Seventy percent of students were comfortable to speak up when observing poor infection prevention practices. Four themes emerged from the analysis of free-text comments (n=812) from these students 1) history of speaking up but concerns not taken seriously 2) willingness to speak up 3) difficulty speaking up 4) fear of retaliation. These themes did not specifically relate to speaking up about poor aseptic technique practices.

A cross-sectional, online survey was used to evaluate nursing students' (n=421) perception of clinical skill development in clinical placements (Stayt and Merriman 2013). Students evaluated their opportunity for practice, supervision and feedback and assessment in aseptic non-touch technique (ANTT). In Stayt and Merriman's (2003) study 73.7% (n=242) of students reported never performing ANTT unsupervised however, the overall response rate for this question was not reported. Always or usually having the opportunity to practice ANTT and for an ANTT assessment by mentors was reported by 55.5% and 36.6% of students respectively. The findings may not be generalizable to all students as first year students made up the largest group (42%) of respondents, or other universities as the placements offered to students were diverse.

There was a high risk of sampling bias due to the use of non-probability samples in these studies (see Tables 2 in Appendix 1). Studies relied upon self-report by students upon practices, with no other perspective being gained from mentors or qualified staff. Only in Geller et al.'s study (2010) nursing students received training. There was no guarantee that students had adequate knowledge to detect breaches in aseptic technique in other observational studies (Ribu et al. 2003; Gould and Drey 2013).

4.4.3.3 Qualitative studies

Five qualitative studies investigated nursing students' experience of learning aseptic technique in clinical placements of which four originated from the UK (see Table 3 in Appendix 1). An exploratory design used semi-structured interviews to explore different aspects of students' experiences of infection control and prevention in clinical placements (Ward 2010; 2011; 2012a; 2012b). In Ward's (2010) study, nursing students' (n=40) experience of infection prevention and control in clinical placements and its effect upon learning was investigated (Ward 2010). Good and poor aseptic technique practices were reported by nursing students. Poor role models had either a positive or negative impact on their learning and practice. Community nurses were praised by students for adapting their practices and maintaining aseptic technique which is in contrast to Gould and Drey's (2013) findings.

In Ward 's (2011) study, students' (n=31) and mentors' (n=32) perceptions of nursing students' infection prevention and control educational needs were explored. Students reported observing conflicting aseptic non-touch technique (ANTT) practices and being concerned about 'doing it the right way'. Students and mentors saw the value of students undertaking ANTT assessments to enhance their learning (Ward 2011). In Wards' (2012a; 2012b) papers, discrepancies were reported between mentors' (n=32) and students' (n=31) perceptions. Mentors' attitudes towards infection prevention and control were perceived to be negative by students and yet mentors claimed to have positive attitudes (Ward 2012a). Mentors perceived students' practices to be slow and time consuming. Aseptic technique was considered to be important but shortcuts were taken by mentors if needed. Qualified nurses did not value infection prevention educational updates whereas students saw them as a reinforcement of good practice, particularly of aseptic technique and needed by staff (Ward 2012b).

Three of these papers (Ward 2011; 2012a; 2012b) appear to have generated findings from the same dataset of nursing students (n=31) and mentors (n=32) which was acknowledged by Ward (2012b). The findings in all papers (Ward 2010; 2011; 2012a; 2012b) came from the same university and NHS Trust and may not be transferable to other universities. The researcher was an infection prevention control lecturer at the university where the studies took place but was likely to be known to the students, increasing the risk of socially desirable responses. The opportunity to

gain other perspectives was overlooked, such as that of the mentor (Ward 2010), nurse educators and infection prevention and control nurses (Ward 2011; 2012b).

A qualitative study explored qualified nurses' workarounds during nursing care as reported by fourth year nursing students (n=96) in their academic assignments (Westphal et al. 2014). Workarounds are defined as deviations from policies, procedures or processes. Deviations from infection control policies and procedures were evident in 46% (n=44) of assignments and identified as a theme and deviations during invasive procedures a sub-theme. Three different occasions were described where aseptic technique was breached on at least one occasion during the insertion of a urinary catheter and two peripheral venous cannulae. Only the students' perspective on qualified nurses' deviations from infection control policies were gained in one university.

4.4.3.4 Summary

None of these studies had the primary aim of exploring aseptic technique. A recurring theme across all studies was that nursing students observed poor aseptic technique practices in clinical practice irrespective of the study design and despite flaws (see Tables 2 & 3 in Appendix 1). Observational studies which were conducted in-house, were small, lacked external validity and introduced the possibility of the researcher being known to students, increasing the risk of selection and response bias. Observational studies that recruited larger samples of students from different universities through membership of an organisation introduced sampling bias.

4.5 Summary of the literature review

Undergraduate nursing students' education and training in aseptic technique was found to be of international interest. The studies were very different in terms of study design, ranging from randomised controlled trials to qualitative studies. No mixed methods studies have been conducted. The studies were methodologically weak and of low quality. In answer to the three critical appraisal questions (see Section 4.2.3) the results of the studies were considered not be valid due to the use of small sample sizes with a high risk of sampling and measurement bias and confounders. The results of studies were weakened by a lack of internal consistency and measurement of treatment effects in experimental studies. The results of the studies may not be useful as many were single site studies and therefore the findings may not be generalizable. Studies were diverse in focus and aim. Only three studies

explored education, training and assessment of aseptic technique as the primary aim (Davey 1997; Gonzalez and Sole 2014; Carter et al. 2017). The literature review question about what nursing students were learning about aseptic technique could not be fully answered by the current literature.

The literature failed to meet two of the objectives about what nursing students are taught about aseptic technique and how they are taught or assessed in undergraduate programmes. A recurring theme was that students witnessed poor aseptic technique practices in clinical practice. The influence of role models for aseptic technique in the simulated environment is yet to be investigated. The studies that explored the effectiveness of different learning and teaching approaches, gave some insight into how aseptic technique may be taught in the university and clinical practice setting. At the time of developing this study, studies explored the learning or assessment of aseptic technique in either the university or clinical setting. No study had specifically explored nursing students' learning of aseptic technique within and across the different communities of practice in university and clinical placements. The contextual factors that influence learning of aseptic technique in the communities of practice in university and clinical placements have not been investigated.

The third and fourth objective of the literature review were partially met. Studies gave some indication of nursing students' level of knowledge, understanding and competency in aseptic technique. However, there was a high reliance upon self-reported knowledge, understanding and competency. Different outcome measures were used and students at different stages of their programme studied, thus making comparisons across studies difficult. Few studies have explored nursing students' understanding of aseptic technique but not in any depth or within the context of those that teach and support their learning of aseptic technique. No studies have explored nurse educators, mentors or infection prevention and control nurses' knowledge and understanding of aseptic technique.

The proposed study will fill these gaps in the current literature. The next chapter will discuss and defend the study design (methodology and methods) used to address these gaps.

Chapter 5 - Study design

5.0 Introduction

This chapter discusses the use of a two phased mixed-methods, sequential explanatory study design (Creswell and Plano Clark 2011) and the methods used to explore when, what and how pre-registration nursing students learn aseptic technique and are taught and assessed. It will first present the research aim, questions and objectives. This will be followed by a discussion of how and why the Communities of Practice theory (Wenger 1998) and Social Learning theory (Bandura 1977) were applied as a theoretical framework to underpin the study. The philosophical standpoint and multiple paradigms: post-positivism and constructivism informing the study will be discussed. This will lead into a discussion of the rationale and use of a two phased mixed-methods, sequential explanatory study design in this study. Phase one (quantitative) and phase two (qualitative) of the study will be discussed sequentially in relation to the design, data collection and data analysis methods used. The penultimate section will discuss the standards applied to ensure the rigour and quality of the study. The final section will discuss the ethical approval process and ethical, confidentiality and consent issues arising from the study.

5.1 Research aim

The research aim was to:

Investigate when, what and how pre-registration nursing students learn aseptic technique and are taught and assessed in pre-registration nursing programmes in the UK.

5.2 Research questions

1. When is aseptic technique taught in pre-registration nursing programmes in the UK?

2. What is taught about aseptic technique in pre-registration nursing programmes in the UK?

3. How is aseptic technique taught in pre-registration nursing programmes in the UK?

4. How is aseptic technique assessed in pre-registration nursing programmes in the UK?

5. How do nursing students', mentors', nurse educators' and infection prevention nurses' knowledge and understanding of aseptic technique compare in two contrasting cases (universities and NHS Trusts)?

6. What contextual factors influence nursing students' learning and knowledge and skill transfer of aseptic technique in two contrasting cases?

The research aim, questions and objectives are shown in Table 10. For clarity knowledge, understanding, and knowledge and skill transfer will be defined. The following definitions of knowledge, understanding, and knowledge and skill transfer will apply to the research questions and throughout the thesis:

Knowledge is the "facts, information and skills acquired through experience or education, the theoretical or practical understanding of a subject" (Oxford University Dictionary 2017).

Understanding is "the ability to understand something, comprehension" (Oxford University Dictionary 2017). To understand is "to perceive the intended meaning of words or interpret or view something in a particular way or knowledgeably aware of the character of nature of" (Oxford University Dictionary 2017).

Knowledge and skill transfer is "the ability to transfer knowledge and skills acquired in one context to other contexts" (Lauder et al. 1999, p. 480)

Table 10.Research aim, questions and objectives

Aim	Phase One Survey - Research questions	Objectives
Investigate, when, what and how pre-registration nursing students learn aseptic technique and are taught and assessed in pre-registration nursing programmes in the UK.	1. When is aseptic technique taught in pre-registration nursing programmes in the UK? 2. What is taught about aseptic technique in pre-registration nursing programmes in the UK? 3. How is aseptic technique taught in pre-registration nursing programmes in the UK? 4. How is aseptic technique assessed in pre-registration nursing programmes in the UK?	1. To establish if a standardised aseptic technique is being taught. 2. To look for any patterns in the way aseptic technique is taught, learnt and assessed in pre-registration nursing programmes in the UK. 3. To explore the influence of different programme variables (e.g. cohort size, number of student intakes) upon learning, teaching and assessment methods and total time spent teaching aseptic technique.

Table 8. Research questions, aims and objectives (continued)

Aim	Phase Two Case-study -Research questions	Objectives
Investigate when, what and how pre-registration nursing students learn aseptic technique and are taught and assessed in pre-registration nursing programmes in the UK.	5. How do nursing students', mentors', nurse educators' and infection prevention nurses' knowledge and understanding of aseptic technique compare in two contrasting cases (universities and NHS Trusts)? 6. What contextual factors influence nursing students' learning and knowledge and skill transfer of aseptic technique in two contrasting cases?	6. To explore nursing students', mentors', nurse educators and infection prevention nurses' knowledge and understanding of aseptic technique 7. To gain a greater understanding of the factors that influence nursing students' learning of aseptic technique in university and clinical practice and knowledge and skills transfer from university to clinical practice.

5.3 Theoretical Framework

The theoretical framework for the study comes from learning theory. Nurse educators use learning theories to underpin the pedagogical approaches used in nurse education (Mackintosh-Franklin 2016). The Community of Practice theory (Wenger 1998) and Social Learning theory (Bandura 1977) will be used together as a theoretical framework to underpin the study. The rationale for use of each theory will be explained in sections 5.3.2 and 5.3.3.

5.3.1 Background to theoretical framework

Aseptic technique may be learnt through practice or 'doing' in simulation and clinical practice, originating from experiential learning theory (Kolb 1984) and situated learning (Lave and Wenger 1991) according to Bland (2011) and Berragan (2011). Simulation is based on constructivism (Bruning et al. 2010) or behaviourist theories (Hope et al 2011). Constructivism refers to "a family of theories and therapies that believe human knowledge and experience involves the pro-active participation of an individual" (Mahoney 1995, p. 44). Behaviourist learning theories focus on observable behaviours, learning occurs by the reinforcement of a response to a particular stimulus (Watson and Rayner 1920; Pavlov 1927; Thorndike 1931; Skinner 1969).

Behaviourist approaches to learning or simulation encourage a teacher led, content driven approach where emphasis is upon instruction, for example teaching the steps of an aseptic technique (Chambers et al. 2013). The focus is upon the acquisition of knowledge and skills and the achievement of measurable outcomes (Mackintosh-Franklin 2016). In contrast, a constructivist approach is where learners are active participants in learning and the role of the teacher is to facilitate learning (Chambers et al. 2013). Knowledge is socially constructed, where meaning is developed from a learner's experiences, for example experience of practising aseptic technique. There is greater focus on the process of learning rather than learning outcomes, making what is learnt less predictable (Chambers et al. 2013; Mackintosh-Franklin 2016). For example, students may not necessarily learn the steps of an aseptic procedure. A constructivist approach to simulation encourages nursing students to think and construct

their knowledge and understanding of aseptic technique through ‘doing’. A constructivist approach is preferable to rote learning the steps of aseptic technique without understanding the underlying principles.

Nurse education, including the use of simulation, has been criticised for favouring behaviouristic approaches over student centred approaches to learning (Kaakinen and Arwood 2009; Kantor 2010; Welch 2011; Horsfall et al. 2012; Chambers et al. 2013; Mackintosh-Franklin 2016). A systematic review of the use of learning theory in the nursing simulation literature by (Kaakinen and Arwood 2009) identified a need for simulation to move away from a behaviourist approach, which is a teaching paradigm towards a learning paradigm, to promote student centred learning.

5.3.2 Communities of Practice theory

The Communities of Practice theory (Wenger 1998) was chosen as a theoretical framework for conceptualising learning ‘by doing’ in a community of practice. Earlier situated learning theory (Vygotsky 1978; Brown et al. 1989) did not recognise that learning takes place in a ‘community of practice’. The following definition of a ‘community of practice’ will be applied throughout the thesis:

“a group of people who share a concern, set of problems or passion about a topic and who deepen their knowledge and expertise in this area by interacting on an on-going basis” (Wenger et al. 2002, p. 4)

This is the most up to date definition of a ‘community of practice’ used in the literature (Kislov et al. 2011; Morley 2016). This definition was also chosen as it captures the social-cultural context of learning which may be important in the learning of aseptic technique. Studies that have applied the Communities of Practice theory (Wenger 1998) to explore nursing students’ experiences of learning and applying bioscience in the clinical setting (Molesworth and Lewitt 2015) and models of clinical learning (Ranse and Grealish 2007; Grealish and Ranse 2009; Grealish et al. 2010) have overlooked defining a ‘community of practice’. In this study it was important to define a ‘community of practice’ to enable understanding of this concept in relation to when, what and how nursing students learn aseptic technique and are taught and assessed at each case-study site.

The university and clinical practice setting may operate as two distinct Communities of Practice with different priorities, philosophies, culture and discourse (Wenger 1998) as shown in Figure 4 and discussed later in this section under '*community*'. Nursing students encounter many different clinical placements during their programme. The above definition of a 'community of practice' implies that nursing students may be exposed to different communities of aseptic technique practice. If the definition of a 'community of practice' is applied to what and how nursing students learn aseptic technique and are taught and assessed, knowledge and expertise in aseptic technique is developed locally through social interaction. The 'communities of practice' theory (Wenger 1998) could be applied to the learning of other core nursing skills. A 'communities of practice' approach could be developed where universities and NHS trusts function as one 'community of practice'.

The literature review (see Chapter 4) suggested that there may be a theory practice gap in aseptic technique. Dissonance between what students learn and are taught about aseptic technique in university and observed to be practiced in clinical placements has been reported by students in some studies (Cox et al. 2014) and not in others (Carter et al. 2017) (see Chapter 4). The Communities of Practice theory (Wenger 1998) was chosen to be applied in this study to explore whether what and how aseptic technique is taught and assessed in university is congruent with what is taught and seen to be practised in clinical placements. It is a reasonable supposition to make that nursing students are only able to transfer their learning from university to clinical practice when what is learnt and taught in university is comparable to what is practised in clinical placements. Greater understanding of what and how nursing students learn aseptic technique and are taught and assessed is required if the standard of aseptic technique practice is to be ensured (see Chapter 1).

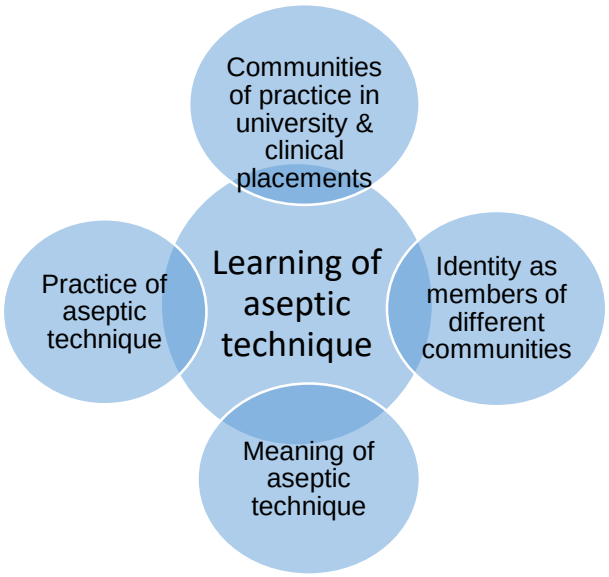
The importance of exploring the socio-cultural context in which nursing students learn and are taught aseptic technique was supported by the literature review findings (see Chapter 4). A recurring theme across studies was that nursing students were being exposed to poor and conflicting aseptic technique practices in clinical placements (Ribu et al. 2003; Geller et al. 2010; Ward 2010, 2011, 2012a, 2012b; Gould and Drey 2013; Carter

et al. 2017). The influence of poor role models upon nursing students' learning of aseptic technique therefore requires investigation.

The Communities of Practice theory (Wenger 1998) has been used to explore nursing students' experiences of learning and applying bioscience in the clinical setting in the UK (Molesworth and Lewitt 2015) and clinical learning in Australia (Ranse and Grealish 2007; Grealish and Ranse 2009; Grealish et al. 2010). It has also been used as a conceptual framework to investigate the transfer of learning from the simulated environment to clinical practice in midwifery students (Dow 2012). No infection prevention studies have been found to use the Communities of Practice theory (Wenger 1998) as a theoretical framework. In Backman et al.'s (2012) study of infection prevention practices in a surgical unit, there was mention of a 'community of practice' but Wenger's (1998) theory was not referenced.

The 'Communities of Practice' theory (Wenger et al. 2002) has been under utilised in the UK to inform nursing students' learning in clinical practice (Morley 2016). The Communities of Practice theory (Wenger 1998) identifies four interlinking but mutually exclusive components which characterise social participation as a process of learning: meaning, identity, practice and community. These have been applied to the learning of aseptic technique for the purpose of this study as illustrated in Figure 4 below.

Figure 4 Communities of Practice



(Adapted from Wenger 1998, p. 5)

Within the Community of Practice theory (Wenger 1998), *Meaning* is continuously negotiated and occurs through participation and reification. Reification "is the process of giving form to our experiences by producing objects" (Wenger 1998, p. 58). The meaning of learning and knowledge is constructed through participation in activities, relationships with other learners and environmental cues (Lave and Wenger 1991). The same qualities that support learning of aseptic technique might impede its achievement (Wenger et al. 2002). Nursing students construct their understanding of aseptic technique through participation and learning in the different Communities of Practice in university and clinical practice. Nursing students' meaning of aseptic technique may not remain static, but evolve as they move from placement to placement. The negotiation of meaning infers it is consensual and achievable, but disagreements or misunderstandings might threaten this (Marshall and Rollinson 2004).

Identity is built as nursing students, as learners, negotiate meaning of aseptic technique from their experiences as members of a community. Teachers and role models of aseptic technique can only play their roles through membership in their respective community of practice in the university or clinical practice setting. Nursing students as newcomers in clinical placements need peripheral participation to engage and get a sense of how the community functions. Students are neither fully on the inside nor

the outside of the community (Wenger 1998). Nursing students develop their knowledge and skills in aseptic technique from practitioners who might be good or poor role models (Ward 2010; Gould and Drey 2013).

As nursing students become more competent they can fully participate in the socio-cultural practices of a community. If rejected or there is conflict, nursing students as newcomers are likely to have difficulty learning (Wenger 1998). Nursing students were found to lack confidence and be reluctant to challenge poor aseptic technique practices for fear of repercussions upon relationships and their placement reports (Ward 2010; Gould and Drey 2013; Carter et al. 2017) (see Chapter4). Some nursing students felt the need to 'fit in' within clinical placements and adopt the aseptic technique practices of their mentor or others, to become part of the community (Ward 2010). Communities of Practice are not formed or static, but evolve over time as different members leave and join (Lave and Wenger 1991). However, Communities of Practice might develop their own preferences and practices of aseptic technique and become static and resistant to change (Mutch 2003).

Practice describes 'doing', the practice of aseptic technique and the historical and social context which gives structure and meaning to what we do. A limitation of the theory is that it does not consider how members' practice might be changed (Fox 2000). Understanding how aseptic technique practice might be enhanced is important (See Chapter 2).

Community is defined by the pursuit of engaging in shared activities, discussions and recognition of participation as competence. A community has three characteristics; mutual engagement, joint enterprise and a shared repertoire (Wenger 1998). *Mutual engagement* occurs through interaction to develop relationships and establish social norms. A *joint enterprise* unites a community of practice by having a sense of belonging and 'of being in it together' with shared accountability. In the pursuit of a joint enterprise, members of a community of practice develop a *shared repertoire* of resources and shared practice e.g. routines and ways of practising aseptic technique (Wenger 1998). The need for trust between members of the community in order to share knowledge is overlooked (Fox 2000). Nursing students have to adapt and learn aseptic technique in the different communities of practice in university and clinical practice which

may have different social norms, sense of enterprise, resources and practices.

5.3.3 Social Learning theory

Social Learning theory recognises both cognitive and behavioural approaches to learning (Bandura 1977) and has been widely used in nursing to underpin the design of simulation (Kaakinen and Arwood 2009). Role modelling is a central tenet of Social Learning theory (Bandura 1977) and the reason for it being chosen as part of the theoretical framework for the study. Role models for undergraduate nursing students in clinical placements have been well investigated (Gray and Smith 2000; Donaldson and Carter 2005; Perry 2009; Grealish and Ranse 2009; Ferguson 2011; Keeling and Templeman 2013; Baldwin et al. 2014). Nursing students have been found to be able to identify the characteristics of a good role model (Gray and Smith 2000; Perry 2009). They can differentiate between good and poor role models in clinical practice, choosing the behaviours or 'good' role models they wish to follow (Donaldson and Carter 2005; Grealish and Ranse 2009; Ferguson 2011; Keeling and Templeman 2013). Similarly, in Ward's (2010) qualitative study, nursing students responded differently when observing poor infection prevention practices, by following or not following poor role models (see Chapter 4).

In contrast, there has been limited research into role modelling in the academic setting (Baldwin et al. 2014). Nurse educators are role models for students in the simulated environment. Nursing students are reported to be exposed to poor role models for aseptic technique in clinical placements (Ribu et al. 2003; Geller et al. 2010; Ward 2010, 2011, 2012a, 2012b; Gould and Drey 2013; Carter et al. 2017) (see Chapter 4). No studies have specifically explored the influence of role models upon nursing students' learning of aseptic technique and for this reason, Social Learning theory (Bandura 1977) will be used to underpin the study.

Learning is said to occur through modelling, imitation and reinforcement, (Bandura 1977,1986). If applied to learning of aseptic technique in simulation or clinical practice, it takes places through observation which is referred to as 'observational or vicarious learning'. Observing a person performing an aseptic technique acts as a guide upon how they should

behave. This is known as learning by modelling. Four key processes are identified as being involved in an observational learning situation which would apply when learning aseptic technique: attention, retention, motor reproduction and motivational processes (Bandura 1977,1986).

Attention processes are concerned with the characteristics of both the model and observer/learner of aseptic technique (Quinn and Hughes 2013). Learning is influenced by the attraction between the observer and model, the value of the behaviour and the complexity and frequency of the modelled stimuli. The importance and value that the role model places upon aseptic technique in the prevention of infection which is reinforced through their behaviour may influence nursing students' learning. Those who are in a position of power or have status, are considered to be more effective models (Quinn and Hughes 2013). This suggests that senior staff and ward managers may be more influential role models for aseptic technique than less experienced staff. A counter argument is that newly qualified nurses may be considered to be more credible role models and up to date than senior nurses who have been qualified for some time and have not received any education and training in aseptic technique since initial training. Individuals who lack self-esteem or confidence are more likely to be influenced by models that are seen as successful (Donaldson and Carter 2005). Even confident individuals will follow behaviour if they deem it to be of importance (Bahn 2001; Quinn and Hughes 2013).

Retention is the importance of remembering the behaviour, using particular strategies such as rehearsal, before performing the behaviour. Simulation allows nursing students to gain opportunity to practise and rehearse aseptic technique in a safe environment before practice upon patients in clinical placements. *Motor reproduction*: the learner must have the ability to perform the observed behaviour and evaluate its effectiveness. Nursing students require knowledge and understanding of the underlying theory and principles of aseptic technique to be able to effectively evaluate their performance (Watts et al. 2009).

Motivational processes are involved. The modelled behaviour is more likely to be learnt if it is reinforced, known as 'vicarious reinforcement' (Bandura 1977). Nursing students are more likely to adopt good aseptic technique practice if this is seen and reinforced in clinical practice. Reinforcement

plays a role in learning, but is not essential and might not completely account for it.

The limitation of Social Learning theory is that it may not be able to explain all behaviour (Bahn 2001). Cognitive processes are involved in learning. Individuals are not simply passive recipients of learning. Learning of aseptic technique might occur without a subsequent change in behaviour. Nursing students as learners may choose not to adopt the observed aseptic technique practices (Wiseman 1994). Nursing students were found not just to imitate the practices of one role model, but pick up and amalgamate practices from different role models (Donaldson and Carter 2005). This is highly likely when learning aseptic technique as nursing students encounter many different role models in university and clinical placements.

5.4 Research Design

5.4.1 Philosophical standpoint and research paradigm

There has been much debate about the merging of qualitative and quantitative approaches in mixed methods research, given that opposing paradigms are at play (Smith 1983; Bryman 1988; Guba and Lincoln 1988). Quantitative research generates scientific and empirical knowledge by testing theories or an experience through observation and measurement. It is embedded in the positivism paradigm that believes scientific truths and laws exist (Bryman 2016). Objectivism is the epistemological tradition upon which the positivism position is placed and seeks to generate objective knowledge which is unbiased and neutral (King and Horrocks 2012). In contrast, qualitative research sits within an interpretivist tradition, that knowledge is produced by understanding human actions and behaviour within their natural setting (Bryman 2016). Constructivism is also identified as a paradigm commonly associated with qualitative research, where understanding is socially constructed through the experiences of individuals (Stake 1995; Creswell and Plano Clark 2011). It is concerned with how people feel and make sense of their lives (King and Horrocks 2012). Constructivism unlike positivism and post-positivism paradigms, generates theory from its understanding of multiple meanings and participants' understanding (Creswell and Plano Clark 2011).

There are four different positions which could have been used to justify the worldview that underpins this mixed methods study. One position is that there is only one 'best' worldview (Creswell and Plano Clark 2011). Pragmatism is commonly adopted as the 'best' paradigm for mixed methods research based on using practical approaches which work, whilst valuing both objective and subjective types of knowledge (Creswell and Plano Clark 2011). Pragmatism has been previously criticised for being a vague reason to justify the use of a mixed methods approach (Bergman 2008). A different position is that multiple paradigms can be used depending on how researchers see and know the social world (Creswell and Plano Clark 2011). Yet another position is that worldviews are influenced by the scholarly community to which researchers belong (Creswell and Plano Clark 2011).

This study has taken the approach that more than one worldview can be used and will depend upon the mixed methods design used (Creswell and Plano Clark 2011). An explanatory sequential study design was used; in phase one, a quantitative cross-sectional survey which was followed by a qualitative, multiple embedded case-study in phase two. Different worldviews or paradigms underpinned the different phases of the study. In phase one, the quantitative cross-sectional survey was informed by a post-positivist worldview which changed in the phase two case-study to a constructivist worldview (Creswell and Plano Clark 2011). The phase two case-study was seen as being a bridge between paradigms (Luck et al. 2006).

5.4.2 Justification for use of a mixed methods design

A mixed methods design was chosen. Mixed methods designs have been variously defined in terms of their methods, methodology, philosophy and purpose (Creswell and Plano Clark 2011). For the purpose of this study a mixed-methods design will be defined as one:

"in which a researcher or team of researchers combines elements of quantitative and qualitative research approaches (e.g. uses of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purposes of depth of understanding and corroboration".

(Johnson et al. 2007, p. 123)

This definition reflects the rationale for using a mixed methods study design. The use of a mixed methods design allowed for a quantitative, cross-sectional survey of nursing students' education, training and assessment of aseptic technique in pre-registration programmes first, followed by an in-depth exploration of nursing students' learning and understanding of aseptic technique using a qualitative case-study. An in-depth exploration of nursing students' learning and understanding of aseptic technique could not be achieved using a quantitative approach alone (Johnson et al. 2007; Bergman 2008; Creswell and Plano Clark 2011). To answer the research questions, both a quantitative and qualitative approach was required (Brannen 2005; Bryman 2006). No previous mixed methods study exploring nursing students' education and training in aseptic technique was found within the literature (see Chapter 4). More generally however, mixed methods studies have been successfully used in exploring infection prevention practices (Damschroder et al. 2009; Williams et al. 2012).

5.4.3 Strengths and weaknesses of a mixed methods design

Mixed methods research is viewed as a research design with its own methodological philosophy (Creswell and Plano Clark 2011), techniques and worldview (Tashakkori and Teddlie 2003). The strength of mixed methods designs is that they can expand the breadth and depth of studies (Bryman 2006). The qualitative and quantitative phases led to a comprehensive and detailed enquiry of nursing students' education and training in aseptic technique, referred to as 'completeness' (Bryman 2006).

The quantitative phase set out to establish when, what and how nursing students learn aseptic technique and are taught and assessed in pre-registration programmes. The purpose of the quantitative phase was to provide a wide, overall picture of educational practice. The qualitative phase intended to produce more detailed and 'rich' data about the meaning of aseptic technique and context of nursing students' learning which could not be achieved in the quantitative phase. This is known as 'complementarity' where one research method enriches, illustrates, clarifies and strengthens the findings from another method (Greene et al. 1989).

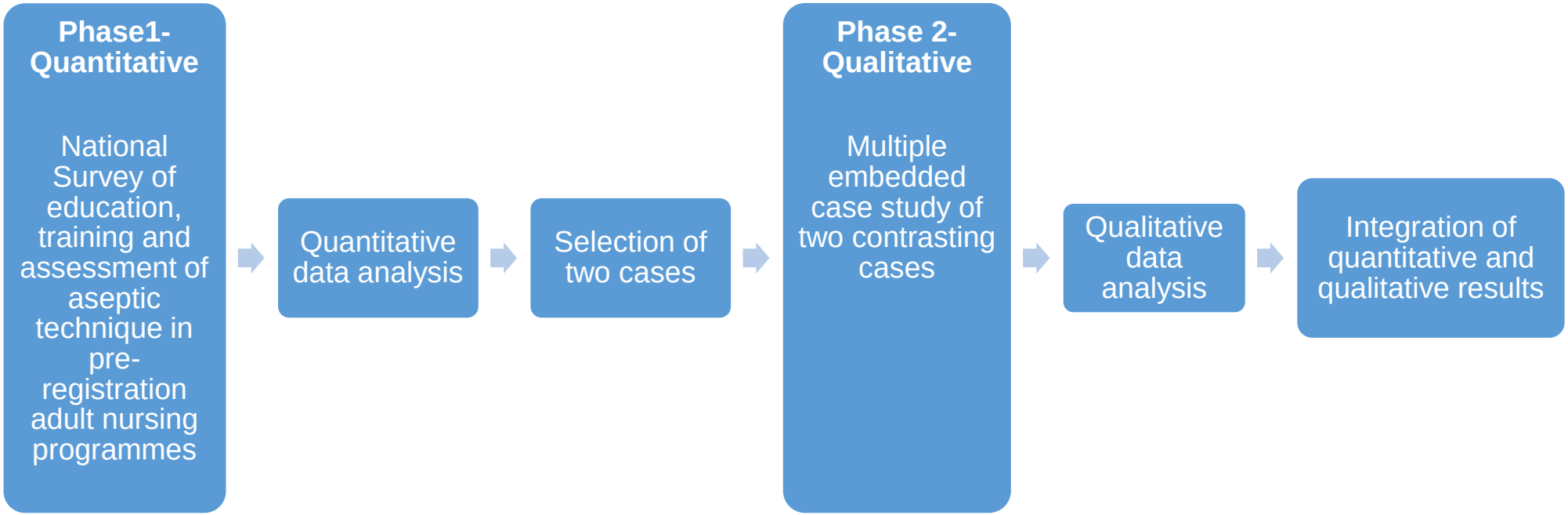
A strength of mixed methods studies is that they offset the weaknesses of qualitative and quantitative methods by combining the strengths of both (Creswell and Plano Clark 2011). A mixed methods design allowed for the phase one, cross-sectional survey of pre-registration education, training and assessment of aseptic technique to inform the selection criteria for the cases in the phase two case-study (Bryman 2006). The use of both qualitative and quantitative approaches were seen to increase the credibility of the study's findings (Bryman 2006).

A limitation of mixed methods designs is that they may be seen as a hybrid method, unrelated to a particular research paradigm (Greene et al. 1989). There is an argument that quantitative and qualitative methods belong to separate and conflicting paradigms, and should not be combined (Creswell and Plano Clark 2011). The challenge of mixed methods designs is that they can be more time consuming and require greater skills to integrate and present data (Creswell and Plano Clark 2011).

5.4.4 Rationale for use of an explanatory sequential study design

An explanatory sequential mixed methods research design has two definitive phases, a quantitative phase followed by a qualitative phase (Creswell and Plano Clark 2011) (see Figure 5 below). This design is distinctive from the other five types of mixed methods designs: convergent parallel, exploratory sequential, embedded, transformative and multiphase designs (Creswell and Plano Clark 2011). An explanatory sequential design was chosen for its ability to first establish trends and relationships in nursing students' education, training and assessment in aseptic technique with quantitative data. This was important in view of the limited understanding of education, training and assessment in aseptic technique in pre-registration programmes within the literature (see Chapter 4).

Figure 5 An explanatory sequential design



(adapted from Ivankova et al. 2006, p. 16)

In phase one, a national survey of aseptic technique education, training and assessment within pre-registration nursing programmes was undertaken (see Figure 5) to answer research questions 1, 2, 3 and 4 (see Section 5.2) in relation to when, what and how aseptic technique is taught and assessed. In phase two, an embedded, multiple case-study was conducted using two contrasting cases (Higher Education Institutes (HEIs) and NHS Trusts) to answer research questions 5 and 6 in relation to nursing students' understanding and learning of aseptic technique. The priority given to the quantitative and qualitative phase within the study was decided at the outset. Priority refers to the relative importance or weight of the quantitative and qualitative approach within a mixed-methods study (Creswell and Plano Clark 2011). Both phases were considered to be equally important in meeting the research aim and answering the research questions. The qualitative phase was of greater educational concern as it enabled a more in-depth exploration of nursing students' understanding and learning of aseptic technique.

One of the strengths of using an explanatory sequential study design was that data was collected in two separate phases at different times. The key strength of this design was that the first phase, the data from the quantitative strand could be used to develop the criteria for the selection of the cases in the subsequent qualitative phase (Tashakkori and Teddlie 2003; Creswell and Plano Clark 2011). A sequential mixed methods study is characterised by an iterative data collection process whereby data in phase one contributes to data collected in the next phase (Driscoll et al. 2007). The separate phases allowed the data collection procedures to be revised following phase one, changing from face to face interviews to telephone interviews. There was opportunity to check whether any new questions were needed in view of the quantitative data. The quantitative data about when, what and how nursing students are taught and assessed, helped to explain and make sense of the qualitative data exploring their learning and understanding of aseptic technique (Ivankova et al. 2006). A challenge of this design is that implementing two consecutive phases can be time consuming. Another challenge is that the researcher has to make decisions about what sampling criteria to use in phase two.

5.4.5 Integration of quantitative and qualitative strands in mixed methods studies

Mixed methods studies are not just about the mixing of two methods, but the integration of qualitative and quantitative approaches in all stages of the research process (Tashakkori and Teddlie 2003). The integration of the quantitative and

qualitative strands in this study occurred at the design, methods, data collection and interpretation and reporting stage of the research process (Creswell and Plano Clark 2011; Fetters et al. 2013). The mixing of the qualitative and quantitative strands was achieved by the first phase being connected and used to build on the next phase and using the theoretical framework to bring together datasets (Creswell and Plano Clark 2011). In the phase two case-study, data triangulation occurred within each case, with the triangulation of interview data, observation data and documentary evidence (Yin 2014).

5.4.6 Integration at the design and methods level

In this study, the integration of the qualitative and quantitative strands occurred at the design and methods level (Creswell and Plano Clark 2011; Fetters et al. 2013). In choosing an explanatory sequential design the intention was for the quantitative strand in phase one to be linked and used to build the phase two, qualitative strand. The phase one, quantitative survey findings informed the sampling strategy and data collection methods for the phase two, qualitative case-study (Fetters et al. 2013). The phase one, quantitative survey findings were used to develop a selection criterion for the two contrasting cases in the phase two case-study. The interview questions for the phase two case-study were informed by the phase one quantitative findings.

5.4.7 Integration at the interpretation level

Data integration at the interpretation and reporting level can occur concurrently or sequentially through the development of narrative reports, data comparison or transformation (Fetters et al 2013, Cresswell and Plano Clark 2007). The qualitative and quantitative strands were kept independent of each other, with the quantitative and qualitative data sets collected and analysed separately (Creswell and Plano Clark 2011). This was in keeping with the use of an explanatory, sequential design and the paradigms underpinning the different phases of the study. There was no merging of data sets during data analysis or transformation of qualitative data to quantitative data or vice versa to avoid data reduction (Driscoll et al. 2007; Creswell and Plano Clark 2011).

The mixing of the quantitative and qualitative strands occurred at the final point of the research process during interpretation (Creswell and Plano Clark 2011). The quantitative and qualitative strands were brought together to synthesise the findings

and answer the research questions and test the theoretical propositions within the discussion (Ivankova et al. 2006; Creswell and Plano Clark 2011).

5.5 Phase one - Quantitative Methods

5.5.1 Rationale for use of a survey design

A survey design was chosen for its ability to collect data on a large scale from HEIs in the UK providing Nursing Midwifery Council (NMC) approved pre-registration adult nursing programmes (Bryman 2016). A survey gathers quantified data to describe a population and explore patterns and relationships between variables (Sapsford 2007). Differences and similarities in the way aseptic technique was taught and assessed in HEIs could be compared using a survey. No other research design could have been used to access this population and explore these variables. The strength of survey research is in its systematic and standardised approach (Sapsford 2007).

5.5.2 A cross-sectional survey

A cross-sectional survey was conducted to explore when, what and how aseptic technique was taught and assessed in pre-registration adult nursing programmes. A cross-sectional survey collects quantitative data, at least two or more variables from a sample of cases at a single time point in order to detect patterns of association (Bryman 2016).

The advantage of a cross-sectional survey is that it allows for variation in a large sample of cases to be explored relatively quickly and is less time consuming than other methods (Bryman 2016). The use of a cross-sectional survey enabled variation in when, what and how aseptic technique was being taught and assessed in pre-registration adult nursing programmes to be investigated across the whole population of HEIs in the UK. Another strength is that cross-sectional surveys allow relationships between variables to be examined.

The survey findings could only reflect educational practices at the time of the survey. Each HEI that agreed to participate was surveyed once. A weakness of cross-sectional surveys is that they do not allow for measurement of change over time (Bowling 2009). A strength is that no major changes in nurse education were taking place at the time of the study in response to NMC directives which might have affected the findings.

5.5.3 Sampling strategy

The entire population of HEIs (n=70) in the four countries of the UK who provide NMC approved pre-registration adult nursing programme were approached and invited to participate in the survey. The whole population was targeted as this was feasible and manageable, increasing the generalisability of the findings (Bryman 2016). HEIs were identified from the search facility on the NMC website. HEIs providing NMC approved pre-registration, adult nursing programmes were searched for rather than mental health, child and learning disabilities nursing programmes for a number of reasons. Some HEIs do not offer NMC approved programmes for all four fields. The intention was to capture the greatest number of HEIs providing undergraduate, pre-registration nursing programmes. A greater number of HEIs provide NMC approved pre-registration adult nursing programmes than mental health, child and learning disabilities programmes. Adult field students also make up the greatest proportion of all pre-registration nursing students. Adult and child nursing students are more likely to gain greater clinical exposure and practice to aseptic technique than mental health and learning disability students.

5.5.4 Recruitment

All Deans/Heads of School for nursing who deliver NMC approved pre-registration adult nursing programmes in the UK were contacted in writing and informed of the study (see Appendix 3). If they agreed for the HEI to take part, they were asked to identify the programme lead/manager(s) or a HEI staff member who would have the greatest insight into the teaching and assessment of aseptic technique. The programme lead/manager(s)/HEI staff member was then approached via email, informed of the purpose of the study and invited to participate (see Appendix 3). Once the programme lead/manager(s)/HEI staff member agreed to be interviewed, they were asked to sign and return a consent form (see Appendix 3). A mutually convenient date and time for the telephone interview was then arranged. Pre-interview information was sent out with some example interviews questions in advance of the interview (see Appendix 4)

5.5.5 Data Collection

5.5.5.1 Structured telephone interviews

Telephone interviews are suitable for obtaining factual, straightforward information such as nursing students' education, training and assessment of aseptic technique. Telephone interviews were considered to be the most cost effective and efficient

way to survey HEIs that are geographically spread than face to face interviews (De Vaus 2002; Bowling 2009). Telephone interviews are considered to be just as effective as face to face interviews in national surveys using structured interviews (Midanik and Greenfield 2003). Telephone interviews allowed for a rapport to be developed and two-way communication between the researcher and programme manager/HEI staff member. Better quality responses and more meaningful data can be produced from telephone interviews compared to a web based survey or postal questionnaire, as non-response and data entry or response errors are less likely and questions can be clarified (De Vaus 2002; Bryman 2016).

5.5.5.2 Use of a structured interview schedule

Structured telephone interviews were conducted using a structured interview schedule (see Appendix 4). Structured interviews are appropriate for use in a survey intending to measure variables in a large population (Bryman 2016). The use of a structured interview schedule ensured a standardised approach, with the same questions being asked of each HEI in the same way and order (Oppenheim 2005; Bowling 2009; Maltby et al. 2010). This was important as up to this point no comprehensive picture of when, what and how aseptic technique was taught and assessed had been undertaken. The interviewer/researcher operated within the confines of 'stimulus equivalence' by not manipulating questions, the order of questions or emphasising particular aspects so that every participant understood the questions in the same way, thus limiting interviewer bias (Oppenheim 2005). This was considered to be important in terms of reliability and making comparisons in data across HEIs. Structured interviews are less flexible and lead to less in-depth data being gathered (Oppenheim 2005; Bowling 2009). The emphasis was upon breadth rather than depth of data within the survey of aseptic technique education in pre-registration programmes. In-depth data would come from phase two of the study.

The structured interview schedule (see Appendix 4) was designed to ask standardised closed questions with pre-coded fixed response answers (Bowling 2009). An interview schedule differs to that of an interview guide which identifies broad areas for discussion rather than specific questions (Maltby et al. 2010). During the development of the interview schedule the mode of telephone interviewing was taken into account. This took cognisance of the number of fixed response answers to questions to avoid issues of recall and retention by participants during the telephone interview, whilst catering for all possible answers

(De Vaus 2002; Oppenheim 2005). The interview schedule was constructed with a navigable layout and clear instructions to assist the researcher to conduct the telephone interviews with ease and code responses at the same time (De Vaus 2002; Oppenheim 2005). The interview questions were developed to answer research questions 1-4. Background information was collected about each undergraduate, pre-registration adult nursing programme. Both research supervisors had experience in quantitative research and survey construction (Camerino et al. 2006; Hasselhorn et al. 2006; Stordeur et al. 2007; Courtenay et al. 2017).

5.5.5.3 The expert panel

Face and content validity of the structured interview schedule were obtained by the use of an expert panel consisting of nine individuals. There were four lecturers, a clinical teacher, a skills tutor, a researcher and two infection prevention and control experts involved in the development, testing and review of questions in the structured interview schedule (Oppenheim 2005; Bowling 2009). These individuals were selected based on their expertise in nurse education, clinical skills development or infection prevention and control. Seven panel members were selected by the researcher and one panel member was the researcher's supervisor. There was one external and independent panel member, who was an infection prevention and control expert from another HEI. The independent panel member was recommended by the researcher's supervisor and approached by the researcher.

The lecturers, skills tutor and clinical teacher all had experience of teaching aseptic technique and supporting students in clinical practice. Two lecturers also had experience as programme managers for the undergraduate pre-registration programme. This was seen as advantageous as they would have greater insight into whether a programme manager would have any difficulties answering the questions. This allowed the questions to be tested and reviewed by individuals who were similar to the target audience. The structured interview schedule was piloted in three phases by the researcher.

5.5.5.4 Internal Pilot - Phase one

In the first phase, six members of the expert panel reviewed the content, wording, interpretation and understanding of questions and appropriateness of responses to questions (De Vaus 2002; Oppenheim 2005). The structured interview schedule

was emailed to these panel members for comment. Respondents were asked to comment on the appropriateness of the questions from a UK perspective, the phrasing and sequencing of questions and the available response categories. All questions were evaluated for response variation, meaning, redundancy and non-response (De Vaus 2002).

Some minor changes were made to the wording and labelling of questions to improve clarity. One question about the ANTT assessment of qualified staff was omitted as this was difficult for HEI staff to answer. Feedback from three members of the expert panel identified that participants would require some pre-warning of the interview questions in order to access and prepare the relevant information to be able to answer some questions. In response to this, pre-interview information was developed which included some sample interview questions to be sent out prior to interviews. Following final approval by the expert panel, pilot work was undertaken to robustly test the survey questions, interview schedule and telephone interview process (Oppenheim 2005).

5.5.5.5 Internal Pilot - Phase two

The second phase of the pilot, pre-tested the interview schedule and interview process (van Teijlingen and Hundley 2001; Lancaster et al. 2004). This could not have been achieved by the use of an expert panel alone (Oppenheim 2005). An internal pilot study was conducted in the researcher's own HEI. Pilot telephone interviews were conducted with two HEI staff. They were both programme managers for the undergraduate, pre-registration, adult nursing programme. The telephone interviews were conducted using the structured interview schedule as they would in the main study. The internal pilot had the purpose of identifying any potential issues or problems (Bryman 2008). This included checking the layout, sequencing of questions and routing instructions within the interview schedule (Oppenheim 2005). Filter questions were tested to make sure they worked and did not skip questions erroneously. The range of responses to answers was checked to ensure that they were exhaustive and pre-coded. The flow, timing, and respondent interest during the pilot telephone interviews was also monitored (De Vaus 2002).

Scrupulous care was taken to refine the survey tool and procedures based on the feedback from the internal pilot. In one pilot interview, the participant could not answer some questions as they were not directly involved in the teaching of aseptic technique. This highlighted that HEI staff who were involved in teaching aseptic

technique were better placed to respond to the survey. The same participant asked for greater guidance upon what information was needed in the survey. However, they admitted to only briefly reading the participant sheet and pre-interview information where this guidance was given. No changes were made to the pre-interview information or the participant information sheet in response. An email prompt, ahead of interviews to remind participants to access the relevant information was identified as a solution to be tested in the external pilot interviews.

A follow-up email or phone call to retrieve any missing information during the telephone interview was another strategy added following the internal pilot to ensure completeness of data. This would only occur in the event of missing data and with the agreement of the participant at the end of the telephone interview. The duration of internal pilot interviews was recorded and was approximately 20-30 minutes. This was congruent with the approximate duration of the telephone interviews stated in the phase one participant information sheet. A final check of the layout of the structured interview schedule was made in readiness for the external pilot.

5.5.5.6 External Pilot - Phase three

Two pilot sites were chosen from the small finite population of HEIs (n=72) that run NMC approved pre-registration adult nursing programmes in the UK. Only two HEI sites were chosen for the external pilot in the event of needing to exclude these from the main study. The structured interview schedule was piloted with two HEI lecturers involved in the delivery of infection prevention and control teaching in the pre-registration undergraduate adult nursing programme. Testing data collection instruments and questionnaires to make sure that questions are comprehensive and well understood is a key objective of an external pilot study (Lancaster et al. 2004).

The duration of the external pilot telephone interviews was 25-30 minutes which was in accordance with the duration of internal pilot interviews. Feedback from the external pilot interviews suggested that the questions were comprehensive and logical in sequence. The two interviewees pre-empted the questions probably as a result of receiving pre-interview information. The interviewer managed this by going with the natural flow of dialogue and re-capping on information previously provided. This was also necessary for the interviewer to keep up with documenting the responses. As a result, one of the interviewees thought that there was some repetition. Both interviewees agreed that the pre-interview information was essential in preparing them for the interview and preventing information being lost from the

study. The interview allowed good opportunity for dialogue about aseptic technique education. This was highlighted in one interview where the interviewee voiced that aseptic technique had been lost from the curriculum and was no longer a core skill that was didactically taught or demonstrated.

One interviewee expressed difficulty gaining access to lesson plans due to individuals having ownership rights and module materials being placed in virtual learning environments such as Blackboard. They considered that retrieving and forwarding lesson plans, learning materials and module documents would place too great a burden on respondents. The researcher did not want to make any assumptions about how HEIs organise themselves and their preparedness to share learning and teaching materials as this might vary. The pre-interview information therefore still encouraged respondents to access and forward module documents, lesson plans and learning and teaching materials to enhance the quality of data.

No major modifications were made to the structured interview schedule or interview process following the external pilot study to prevent data from the pilot sites being included in the main study. Data from a pilot study should not usually be included in the main study or analysis of data to avoid the risk of contamination (van Teijlingen and Hundley 2001; Oppenheim 2005). The risk of contamination was not a concern in this study as participants in the external pilot were not exposed to an intervention, only the interview questions. Completeness of the dataset was considered very important.

5.5.5.7 Conduct of the telephone interviews

Telephone interviews were conducted with the programme manager or nominated staff member from each participating HEI. Only participants in HEIs who agreed to take part were contacted and interviewed by telephone (De Vaus 2002). Pre-arranging the date and time of interviews ensured that participants made themselves available to complete the telephone interview, limiting the effect of non-response that might occur in general population surveys (De Vaus 2002). Although time had been set aside there was no guarantee that participants were free from work distractions and fully focused upon the interview taking place. This was a limitation of using telephone interviews in comparison to face to face interviews (Jackle et al. 2006). Not being able to pick up on non-verbal cues during telephone interviews was not seen as a major disadvantage as the survey was designed to elicit factual information rather than personal and sensitive information from

participants (Bryman 2016). The influence of the interviewer and researcher, being an academic from another university upon the interviews cannot be overlooked. Participants may have felt compelled to provide socially desirable responses that put their HEI in a good light in terms of educational provision in this area (De Vaus 2002). Alternatively, participants might have perceived competition and withheld information.

5.5.6 Data Analysis

In a mixed-methods, sequential explanatory design, data is analysed separately in two phases: quantitative data first, followed by qualitative data (see Appendix 5) (Creswell and Plano Clark 2011). Descriptive and inferential statistical analyses from phase one data were undertaken using Statistical Package for the Social Sciences (SPSS). Descriptive statistical analyses were used to describe, summarise and look for any patterns in data (Dancey et al. 2012), upon when, what and how aseptic technique is taught and assessed across undergraduate adult nursing programmes. Inferential statistical analysis was performed to explore relationships between variables and to generalise findings from data to the wider population (Dancey et al. 2012). Univariate and bivariate analysis was performed.

5.5.6.1 Type of data generated

Nominal or categorical data was mostly produced from the survey questions. Only Question 6 yielded dichotomous data. Interval or ratio data was gathered in Questions 9b, 10b, 11b, 12b about total time in minutes spent teaching. Data on total time spent in teaching was not normally distributed (see Chapter 5) and therefore required the use of non-parametric tests (Dancey et al. 2012)

5.5.6.2 Statistical analysis

Frequency distributions, measures of central tendency and dispersion were calculated and reported to summarise data upon the learning, teaching and assessment of aseptic technique (Bryman 2016). A number of statistical tests were undertaken which included: Chi-square test; Cramer's V; Fisher's Exact test; Mann Whitney U test; Kruskal Wallis test and Mantel Haenszel test for trend.

5.5.6.3 Measures of central tendency

Measures of central tendency were used to measure the average time spent teaching aseptic technique each year and in total across programmes (De Vaus

2002). The mean was calculated as an appropriate measure of central tendency of continuous data (Dancey et al. 2012). Data on time spent teaching aseptic technique each year and in total across programmes was skewed, justifying the use of the median which is more reliable (Hagger-Johnson 2014). The median is considered to be a more appropriate measure than the mean for use in the Mann Whitney U test and Kruskal Wallis test (Dancey et al. 2012).

5.5.6.4 Measures of Dispersion

Measures of dispersion were used to establish the variations in teaching, learning and assessment of aseptic technique across HEIs (Hagger-Johnson 2014). The range was used to calculate the difference between the minimum and maximum time spent teaching aseptic technique in each year and across the programme and student intake (Dancey et al. 2012; Hagger-Johnson 2014). Standard deviation measures the average distance from, or variation around, the mean for normally distributed data (Bryman 2016). The standard deviation was reported to accompany the mean time spent teaching aseptic technique. The interquartile range, like the median, was reported as data on time spent teaching aseptic technique in each year and across the programme, was skewed (Hagger-Johnson 2014). The inter-quartile range calculates the middle 50% of data and is more reliable than the range as it is not affected by extreme values (Dancey et al. 2012).

5.5.6.5 Chi-square test

The Chi-square test is a non-parametric test which was chosen for its ability to make inferences about the relationship between two categorical or nominal variables cross-tabulated in a contingency table (Bryman 2016). The Chi-square test works out the difference between the observed frequencies and expected frequency in each cell of a contingency table (Bryman 2016). This test was also chosen for being powerful enough to test statistical significance and confirm that the frequency of each category from the contingency tables was different and did not occur by chance, rejecting the null hypothesis (Bryman 2016). The Chi-square test was only used where the expected frequency/values were 5 or greater in each cell (Polit 2014). The limitation of using non-parametric tests such as the Chi-square test is that they are less powerful than parametric tests in finding significant differences (Schneider et al. 2004).

5.5.6.6 Cramer's V

Cramer's V was calculated to test the strength of the relationship between nominal variables (Bryman 2016). Cramer's V can provide some indication of the strength but not the direction of the relationship between variables (Bryman 2016).

5.5.6.7 Fisher's Exact test

A Fisher's exact test was used as it had adequate power to test statistical significance where the expected frequency was less than 5 in a cell of a contingency table (Polit 2014). A Fisher's exact test is used for small sample sizes and differs to a chi square test in using exact distributions rather than large sample approximations (Agresti 2007).

5.5.6.8 Mann Whitney U test

A Mann Whitney U test was used to explore if there was any statistical difference in time spent teaching aseptic technique between programmes with one or two student intakes per year. A Mann Whitney U test calculates the statistical differences between mean rank scores for two levels of a categorical variable on a continuous variable (Agresti 2007, Maltby et al 2007). Data on time spent teaching aseptic technique was not normally distributed warranting the use of a non-parametric, Mann Whitney U test for two independent groups rather than a parametric, t-test (Dancey et al 2012).

5.5.6.9 Kruskal Wallis Test

A Kruskal Wallis test was used to establish whether there were any statistical significant relationships between time spent teaching aseptic technique and cohort size. The Kruskal Wallis test is a non-parametric test (Dancey et al. 2012). The Kruskal Wallis test was used as opposed to the Mann Whitney U test as there were three separate groups: small (<100 students), medium (101-300) and large cohort size (≥301) (Dancey et al. 2012).

5.5.6.10 Mantel Haenszel test for trend

A Mantel Haenszel test was used to look for any associations between cohort size and different teaching and assessment methods. Cohort size was categorised into small, medium and large cohorts, ordinal categorical variables. The Mantel Haenszel test is a test for trend in ordinal categorical variables (Agresti 2007). The Mantel Haenszel test is used to test for independence in 2 x 2 x *K* (number of strata)

contingency tables. It conditions on the row and column totals in each partial table and determines the counts in all cells of the table, like the Fisher's exact test. The greater the sample size, the more reliable the approximation irrespective of whether the number of strata is small or large (Agresti 2007).

5.6 Phase two - Qualitative Methods

5.6.1 Definitions of a case-study

A widely accepted definition of a case-study is;

"An empirical enquiry that investigates a phenomenon in depth within its real context, when the boundaries between phenomenon and context may not be clearly evident"

(Yin 2009, p. 13)

This definition has been adopted in the thesis, as this best reflected what was aiming to be achieved by using a case-study design. There was a need to understand nursing students' learning of aseptic technique within the different Communities of Practice in university and clinical practice. This was a major gap in the literature (see Chapter 4). Yin's definition (2009) is similar to Robson's (2002) definition which recognised the need for multiple sources of evidence to understand a phenomenon in its real life context. The definition by Yin (2009) stresses the importance of an in-depth exploration of the phenomenon within its own context and the boundaries between the two. It is of particular relevance in this study to explore the boundaries between learning aseptic technique in the university and clinical practice setting.

Yin's (2009) definition is more explicit than Stake's (1995) and Merriam's (1998) earlier definitions of a case-study. While Stake's (1995) definition recognises the complexities of a case and importance of understanding the issues surrounding the case, there is less emphasis upon exploring the relationship between the case and its context. Merriam's definition (1998) is more complex, referring to case studies as being particularistic and heuristic. *Particularistic* means that a particular event, phenomenon or situation is the focus of case studies. *Heuristic* that case studies help to explain understanding of the phenomenon under study (Merriam 1998). These characteristics are also captured within Yin's (2009) definition.

5.6.2 Rationale for use of a case-study design

A case-study design was chosen for its unique ability to examine not only the complexity of the phenomenon being explored but exploring it in the real life setting (Scholz and Tietje 2002; Yin 2014). The phenomenon being studied was the learning of aseptic technique within the context of the university and clinical setting. The university and clinical practice and each case-study site were conceptualised as putative Communities of Practice. Uncovering the contextual conditions and influences upon learning of aseptic technique in these putative Communities of Practice was considered to be of major importance. A case-study design was appropriate for answering the 'how' explanatory question, around how learning of aseptic technique is transferred from university to clinical practice (Yin 2014). An in-depth exploration of individuals' understanding of aseptic technique within the context of where it is learnt or practised could not have been achieved through other research methods.

Case-study research has been criticised for lacking rigour compared to other methods, as systematic procedures have not been followed and researchers have based their findings and conclusions upon equivocal evidence (Yin 2014). This was overcome in this study by using a case-study protocol to plan and guide procedures. Case-studies have been commonly used in educational research (Yin 2014). Case-studies have been used effectively to explore infection prevention practices (Courtenay 1998; Prieto and Clark 2005; Williams et al. 2012). A case-study design can be used independently or as part of a mixed methods study, dependent on the research questions (Yin 2009).

In this thesis, a case-study design was used as part of a larger mixed methods study. A case-study entails qualitative and quantitative data to be collected to gain understanding about the case or a particular phenomenon (Stake 1995; Luck et al. 2006; Yin 2009; Fetters et al. 2013). Defining the 'cases' in case-study research can be difficult (Yin 2014). These difficulties were initially encountered when designing the study. This challenge was overcome by considering the research questions being addressed and discussing and defending the 'case' with research supervisors. In this case-study, the cases were two universities and their associated NHS Trusts from England and Wales that were previously surveyed in phase one of the study. The case was an organisation rather than an individual, process, program or event (Yin 2014). Stake (1995) states that cases which are similar, different or

unique compared to other cases may be of interest to researchers. In this study, two contrasting cases were of interest.

5.6.3 A multiple-case (embedded) design

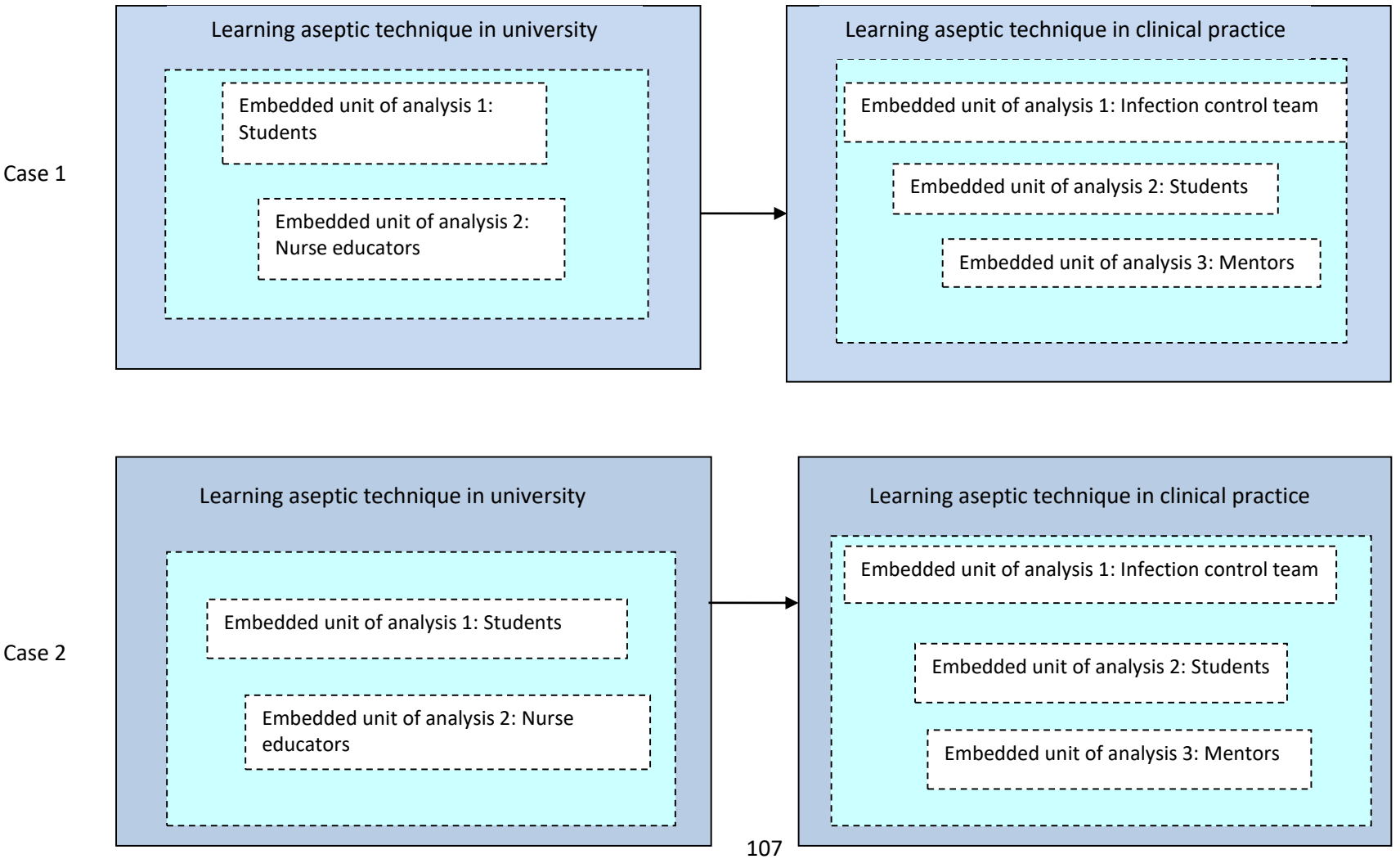
A multiple-case embedded design is when a study has more than a single case and one or more different units of analysis within each case respectively (Scholz and Tietje 2002; Yin 2014). A multiple-case embedded design was justified rather than a single-case design as there was no one case that was especially typical, rare, extreme or highly relevant (Yin 2014). The aim was to compare two contrasting cases.

Multiple-case designs, even when using just two cases, are considered to be preferable and more robust than single-case designs (Yin 2014). The advantage of using multiple cases is equivalent to that of multiple experiments, so that literal and/or theoretical replication can be achieved (Yin 2014). An embedded design was chosen to enable analysis at more than one level at the individual (recipients/providers of education) and organisation level (universities and NHS Trusts) (Yin 2014). This has the advantage over a holistic design which looks at only the organization or a program as a whole (Yin 2014). The disadvantages of multiple-case designs are that they can be more resource intensive and time consuming (Yin 2014). A danger of an embedded design is that it can become too focused on the individual level or sub-unit of analysis and ignore the larger unit of analysis at the organisational level.

A collective case-study was used, where a number of cases are examined simultaneously or in sequential order, to make comparisons and gain a broader understanding of a definitive phenomenon (Stake 1995). The rationale for this, was that there was choice in the cases that could be studied. Furthermore, interest in exploring not just the case, but also the phenomenon which sets it apart from an instrumental and intrinsic case-study (Stake 1995; Scholz and Tietje 2002; Yin 2014) The case-study was descriptive in nature, intending to describe ‘the case’ or phenomenon in the real world context (Scholz and Tietje 2002; Yin 2014). A descriptive case-study fitted with the research aim and questions (Scholz and Tietje 2002; Yin 2014).

A multiple-case embedded design was chosen using two contrasting cases and the different communities of practice (universities and NHS Trusts) (see Figure 6). The selection of the two contrasting cases is discussed in the next section (5.6.4)

Figure 6 Two Cases and Communities of Practice (universities and clinical practice) *(adapted from Yin 2014, p.15)*



A multiple case design enabled similarities and differences between the cases and context of nursing students' learning of aseptic technique to be explored (Baxter and Jack 2008). At the organisational level, nursing students' learning of aseptic technique was explored within each university and clinical placements. At the individual level, nursing students, mentors, nurse educators and infection prevention and control nurses' understanding of aseptic technique was investigated.

5.6.4 Selection of cases

Two contrasting cases (universities and NHS Trusts) were chosen from those universities that completed phase one of the study. The following selection criteria (see Table 11) for good educational practice with regards to aseptic technique were developed based on the phase one survey findings.

Table 11. Criterion for good educational practice

Criteria
Teaching/Learning
1. Reported use of an innovative approach to aseptic technique education
2. Reported identification of the use of the ANTT guidelines to guide learning & teaching of aseptic technique
Assessment in clinical practice
3. Students do the same ANTT assessment as qualified staff
4. Performance based criteria for assessment of aseptic technique
5. Formative or summative competency assessment of aseptic technique in each year of the programme
Assessment in university
6. Summative OSCE/practical assessment of aseptic technique
7. Formative OSCE/practical assessment of aseptic technique
8. Other types of formative peer/faculty assessment of aseptic technique

Each university that completed the phase one survey was scored, against the eight criteria in Table 11 using phase one survey data (see Appendix 6). The two geographically closest cases from two different countries of the UK, England and Wales, were chosen from those universities who met the

least criteria (0-1) (Case 1) and the most criteria (4) (Case 2). They were contrasting cases in terms of:1) use of innovative approaches versus no use of innovative approaches to teach aseptic technique 2) Use of a formative assessment versus no use of a formative assessment versus of aseptic technique in university 3) summative assessment of aseptic technique in university versus no summative assessment of aseptic technique in university.

An innovative approach was considered to be an idea, practice or object that is perceived as novel by an individual or others in the community of nurse education (Rogers 2003). This was the only university that identified the use of innovative approaches in teaching aseptic technique. They were similar in only one criteria, in both identifying the use of ANTT guidelines to guide teaching of aseptic technique. This was considered a strength rather than weakness, providing the opportunity to explore whether the implementation of ANTT guidelines in teaching were the same or different. These two contrasting cases from England and Wales were used to test the theoretical propositions of the study and address the research questions.

Both cases were selected as they appeared to be contrasting cases and therefore direct replication was not sought (Yin 2014). A greater number of cases (6-10) are required for theoretical replication, where the cases are used to test and provide support for the initial theoretical propositions (Yin 2014). The use of more than two cases was not considered viable, given the available resources and geographical spread of UK universities. Theoretical replication to predict contrasting results was therefore considered unachievable (Yin 2014).

5.6.5 Theoretical propositions of the case-study

Seven theoretical propositions were to be tested by the case-study, five based on the Communities of Practice theory (Wenger 1998) and two on Bandura's Social Learning theory (1977) (see Table 12).

Table 12.Theoretical propositions of the case-study

Theory	Theoretical Propositions
Communities of Practice theory (Wenger 1998)	1. Students' understanding and practice of aseptic technique is contexualised within different 'Communities of Practice' in university and clinical practice. 2. Learning in the 'community of practice' in university assists students to develop knowledge and skills in aseptic technique and provide meaning through 'learning by doing' and co-participation. 3. Students engage in learning and the practice of aseptic technique within the boundaries of the different Communities of Practice in the university and clinical setting. 4. Aseptic technique practices learnt in university are only legitimatised and reinforced if similar practices are observed in clinical practice. 5. Knowledge and skill transfer from university to clinical setting is aided where the learning context in university is authentic and replicates clinical practice and situations where aseptic technique is practised.
Social Learning theory (Bandura 1977)	6. Poor role modelling of aseptic technique in clinical practice influences students' learning of aseptic technique. 7. Students may adopt good or poor aseptic technique practices depending on the role models observed in their clinical placement in order to belong and become participating members of the community of practice.

5.6.6 Sampling strategy

A purposive sample of third year adult nursing students n=10 and their mentors n=10, nurse educators n=4 and infection prevention and control nurses n=10 were intended to be recruited from each of the two case-study sites. Purposive sampling was chosen to ensure that only participants who met the inclusion criteria (see section 5.6.6.1) were recruited to the study (Ritchie et al. 2014).

Nurse educators were targeted as they were involved in the delivery of aseptic technique teaching or planning or management of the pre-registration curriculum. Infection prevention and control personnel were considered to be important in understanding the nature of the relationship and interaction between their team, clinical staff and universities. Mentors were included for their role supporting the learning, supervision and assessment of third year students in clinical placements (NMC 2010). Third

year students were studied as they should be at the stage of the programme where they have been taught the principles of asepsis and be able to demonstrate competency in performing a safe aseptic technique (NMC 2010). By this stage they should have had adequate clinical exposure and opportunity to perform an aseptic technique for different procedures in a variety of settings.

Infection prevention and control personnel of NHS Trusts and nurse educators had to agree to participate but there was no specific inclusion or exclusion criteria. All infection prevention and control nurses and nurse educators should have knowledge about aseptic technique. The inclusion and exclusion criteria for students and mentors is summarised below.

5.6.6.1 Inclusion criteria

Inclusion criteria for students:

- In the third year of their nursing programme
- Successfully passed second progression point of the NMC Essential Skill Cluster: Infection Prevention and Control, learning outcome 25 (NMC 2010) (see chapter 2)
- Agreement to take part in the study

Inclusion criteria for mentors:

- Undertaken NMC approved mentorship training and deemed competent
- Currently mentoring a third year student in practice

5.6.6.2 Exclusion criteria

The following exclusion criteria applied to:

- Any student who had not agreed to participate in the study
- Mentors who had not met NMC on-going requirements for mentorship or had not agreed to participate.

- Mentors whose students had not agreed to participate in the study

5.6.7 Recruitment

Approval was gained from the Deans/Heads of School for nursing of the two universities before students and nurse educators were recruited to the study. It was not assumed that the two universities were willing to be case-study sites as they had been involved in phase one of the study. Mentors and infection prevention and control nurses were only recruited to the study once research and development approval was granted from their respective organisations.

Third year nursing students were informed about the study in the university setting. A short advertisement was also placed on the university virtual learning environment inviting third year adult nursing students to take part (see Appendix 7). This allowed students to volunteer if they wished to take part in the study. Only nurse educators involved in the teaching of aseptic technique, that were identified through the programme manager were approached via email and invited into the study.

Mentor links and senior sisters in the respective NHS trusts were informed about the study through meetings or via email/letter. A poster was placed in clinical areas in health boards/NHS trusts to increase awareness of the study (see Appendix 7). Mentors of students recruited to the study were approached and invited into the study by letter/email in NHS Trusts. The Infection control and prevention teams of the respective NHS Trusts were contacted via email/letter and invited into the study.

Recruitment did not continue until the desired number of participants was achieved for a number of reasons. Time restricted more than one cohort of third year students from being approached at each case-study site. The number of mentors approached and recruited was dependent on their students agreeing to participate. There was also a finite number of infection prevention and control nurses and nurse educators that could be recruited. All participants received a participant information sheet and were asked to sign a consent form if they agreed to be interviewed (see Appendix 7). A mutually convenient date and time was then arranged for interview.

5.6.8. Data collection

5.6.8.1 The case-study protocol

A case-study protocol was developed (see Appendix 8) and used to help plan the case-study and anticipate any issues (Yin 2014). The reliability of a case-study is enhanced by the development of a case-study protocol to guide the researcher and keep the case-study focused (Yin 2014). The use of a case-study protocol is considered to be crucial when using a multiple-case design (Yin 2014).

The case-study protocol provided an overview of the aim, objectives and theoretical framework for the case-study and described the data collection procedures and questions, increasing the reliability of the case-study (Yin 2014). The data collection procedures identified the contact details for doing fieldwork at the case-study sites and described the data collection plan. The data collection plan specified the type of evidence: the events to be observed, participants to be interviewed and the documents to be retrieved (see Appendix 8). The data collection questions are the case-study questions, to guide the line of the enquiry and should not be confused with the questions being asked of participants. The data collection questions should be in the forefront of the researcher's mind when collecting data to keep the case-study focused. Each question should identify a list of possible sources of evidence.

The case-study protocol should firmly distinguish between: level 1 questions, those posed to interviewees in each case (university and NHS Trusts): level 2 questions which are the broad questions of inquiry for the individual or single cases and Level 3 questions those asked of the pattern of findings across multiple cases (Yin 2014).

5.6.8.2 Use of in-depth interviews in case-study research

In-depth interviews are frequently used in case-study research and are invaluable sources of evidence (Stake 1995; Yin 2014). In this study, in-depth interviews were considered to be a central data source for exploring nursing students' learning and understanding of aseptic technique from multiple views and perspectives of the case (Stake 1995). This allowed nursing students' learning of aseptic technique to be explored from the

perspective of the student, those that teach and supervise students in university and clinical practice and experts in infection prevention and control. In-depth interviews gave participants the time and capacity to provide an account of the issues that were important to them (Green and Thorogood 2014). The meaning of the term ‘aseptic technique’ and different participants’ knowledge and understanding of aseptic technique could be investigated for the first time within the same study. In-depth face to face interviews were originally planned but changed to telephone interviews following the selection of case-study sites after phase one of the study. Telephone interviews were considered to be more viable on the basis of experience of conducting phase one.

5.6.8.3 Telephone interviews in qualitative research

Telephone interviews have been positively evaluated for allowing expansion and comprehensiveness in social research (Bryman 2016). However, there is limited research into the use of telephone interviews in qualitative research (Irvine 2010; Bryman 2016). Telephone interviews in qualitative research can be more cost-effective than face to face interviews (Irvine et al. 2012b). The shortcomings of telephone interviews are the inability to pick up on non-verbal cues, develop a rapport, and sustain interaction and possible loss of contextual data (Irvine 2010; Irvine et al. 2012b; Trier-Bieniek 2012).

The choice of whether telephone interviews are used instead of face to face interviews should be determined by the line of enquiry, information to be gained, participants to be interviewed and data analysis to be undertaken (Irvine et al. 2012a). Interviewing participants about nursing students’ learning of aseptic technique was not likely to be highly sensitive for individuals. The need to pick up on non-verbal cues was not seen as crucial to the line of enquiry. Telephone interviews were therefore not considered to be detrimental in weakening the study.

5.6.8.4 Interview Guide

An interview guide was developed (see Appendix 9) based on the literature review and phase one findings. The interview guide was informed by the phase one findings and this was another connecting point between the quantitative and qualitative approaches used (Ivankova et al. 2006). In

case-study interviews it is recommended that a small number of issue focused questions should be prepared ahead to limit veering from the case-study protocol (Stake 1995; Rubin and Rubin 2011). Questions were formulated in the interview guide (see Appendix 9) to ensure appropriate phrasing of questions.

The questions were informed by the theoretical frameworks underpinning the study. For example, the interview questions asked about nursing students' learning of aseptic technique in the different 'Communities of Practice' (Wenger 1998) in university and clinical practice. Another question asked about the transfer of aseptic technique from the university setting to clinical practice conceptualising these as distinct 'Communities of Practice'. The influence of role models in university and clinical practice was not directly asked, to avoid leading participants to answer in a particular way. However, by asking participants about what may influence nursing students' learning of aseptic technique in the university and clinical practice setting, there was opportunity to discuss role models if desired. This is an example of how Social Learning theory (Bandura 1977) was considered during the development of the interview questions.

5.6.8.5 Pilot interviews

Pilot in-depth telephone interviews were conducted with a student, mentor and nurse educator to run through the interview process and check the interview guide (Braun and Clarke 2013) (see Appendix 9). The student, mentor and nurse educator were from the researcher's own university and not from one of the case-study sites. Data from the pilot interviews were therefore excluded from the study. The pilot interviews allowed the researcher to practise their interview technique and test the interview questions and recording equipment (Berg and Lune 2014). No issues were encountered with the interview guide or recording equipment. During the first interview, permission to record the telephone interview was initially asked after the introduction but was subsequently changed to the beginning of the telephone call, to capture any background information about the participant. When asked about the underlying principles of aseptic technique, many participants experienced difficulty in answering and sought clarification about what was being asked. The question often had to be re-

phrased to ask ‘what rules they might apply when undertaking an aseptic technique?’ to obtain a response.

5.6.8.6 Conduct of the in-depth interviews

All interviews were conducted by telephone and digitally recorded for transcription. The interviews consisted of five phases: 1) introductions - self and research 2) interview brief 3) beginning the interview/warm up 4) during the interview questions 5) closing the interview (Ritchie et al. 2014) (see interview guide in Appendix 9). A friendly and non-threatening manner was used to develop a rapport with interviewees and gain trust. The degree of structure permissible in in-depth interviews will depend on the epistemological position of the researcher and the extent of knowledge upon the given topic (Ritchie et al. 2014) Given the scarcity of knowledge and understanding in this area and the previously stated epistemological stance for this phase of the study, a flexible and exploratory approach was taken.

The interview guide provided structure but was used flexibly (King and Horrocks 2012). The order and phrasing of questions were not always identical to that of the interview guide. The questions were adapted to be sensitive to issues from the perspectives of different participants. A balance was struck between the interviewer guiding the interview to cover important issues and providing interviewees with the opportunity to explore their own perspectives, allowing unanticipated issues to emerge. Open ended questions were used to encourage discussion and exploration of the issues. Probing was used to demonstrate responsiveness as an interviewer and to elicit greater detail, information and explanation (Ritchie et al. 2014).

There was the potential threat of students perceiving a power balance between themselves as students and the researcher being a lecturer. There was also a risk of coercion and students providing social desirable responses to meet the lecturer’s expectations. This was minimised by students not being from the same university where the researcher worked. Students were also reminded at the beginning of the interview, that the interviewer should be seen in the capacity of a researcher rather than a lecturer. Some infection prevention and control nurses and one mentor

from one NHS Trust were known to the researcher. This could not be predicted as it was dependent upon who agreed to participate in the study.

5.6.8.7 Documentary evidence

Documentary evidence from the two case-study sites: universities and NHS Trusts were collected. Documents assisted in corroborating the evidence from other data sources in the case-study (Yin 2014).

The researcher had insight into the type of documents that might be acquired from universities from their role as a lecturer. Documentary evidence requested from universities included lesson plans, student information, assessment documents, teaching presentations and materials. These documents helped to corroborate the findings from interviews and observations about what and how aseptic technique is taught and assessed and what is learnt.

Advice was sought from research supervisors with a background in infection prevention and control and an infection control specialist nurse regarding infection prevention and control documents. Current infection policies/guidelines and infection control audits including hand-hygiene audits were retrieved from infection prevention teams where possible. Infection rates for *Clostridium difficile*, meticillin-resistant *Staphylococcus aureus* (MRSA) and meticillin-sensitive *Staphylococcus aureus* (MSSA) bacteraemias for each NHS Trusts were accessed from the public health websites in the respective country. Teaching presentations used in the education and training of health care professionals in aseptic technique were obtained. These sources gave contextual information about infection prevention and control practices in the NHS Trusts.

Any documentary evidence which might clarify the nature of the relationship between the university and NHS Trusts was requested. For example, minutes of meetings or memorandum of agreements might provide insight into communication and partnership working between the universities and NHS Trusts. Role descriptors might indicate joint roles and responsibilities for infection prevention education across university and NHS Trusts.

5.6.8.8 Observation of teaching

Observation of aseptic technique teaching sessions in university was planned at both case-study sites. Observation methods was chosen for permitting the examination of behaviour and activity in the real life, natural setting of the classroom (Morgan et al. 2017). The purpose of observing teaching sessions was to gain greater insight into what and how pre-registration nursing students learn aseptic technique and are taught and assessed within the context of the 'community of practice' in university. Observation of teaching gave the opportunity to observe role models for aseptic technique in the university setting. Any teaching session where aseptic technique was taught or practised in an invasive or non-invasive clinical procedure was targeted to be observed.

There are two types of observation: participant observation, where the observer participates in activity and non-participant observation, where the observer is not involved (Hammersley and Atkinson 2007; Morgan et al. 2017). Non-participation observation was undertaken in teaching sessions to ensure that interaction or teaching was not compromised by the involvement of the researcher. Participant observation was undertaken as a simulated patient in an OSCE assessment at case-study two. This approach was used to make sure that the researcher's presence was not intrusive and did not impact on the examination process.

The influence of being directly observed and observer bias are two major concerns in using observation (Swanwick 1994; Morgan et al. 2017). There may be different levels of awareness of observation taking place and the presence of the observer as a researcher might change behaviour, commonly known as the Hawthorne effect (Roethlisberger and Dickinson 1939; McCambridge et al. 2014; Morgan et al. 2017). The Hawthorne effect in research and in studies of infection control practices such as hand-hygiene has been the focus of much attention (Adair 1984; Diaper 1990; McCambridge et al. 2014; Gould et al. 2017b). Observer bias, is where an observer has their own perceptions and judgements about what is observed and therefore true objectivity is widely regarded as unachievable (Morgan et al. 2017).

A semi-structured observation schedule was developed based on the literature, phase one survey findings and theoretical propositions of the case-study (see Appendix 10) to keep the researcher focused and consistent in their approach to observation. Unstructured, participant observation is usually associated with qualitative approaches whereas structure, non-participant observations with quantitative approaches (Punch 2014). Unstructured observation typically does not employ an observation schedule for recording of behaviour (Bryman 2016). The level of structure in observation can vary like other data collection methods such as interviews (Punch 2014).

In this study, semi-structured observation was undertaken using an observation schedule combining the strengths of both structured and unstructured observation. Structured observation was undertaken of what was being taught and assessed about aseptic technique and how. The behaviour of educators and students was observed (Punch 2014). This was complemented with more general information about how learning of aseptic technique in these universities was organised.

5.7 Data management and analysis

All case-study data: interview, documents and observations were stored in Nvivo 10 for analysis. Data were read in detail and research memos written using Nvivo 10 if any key issues came to light that might trigger analysis at a later stage (Dey 1993). These processes allowed the researcher to become fully immersed and familiar with all data (Ritchie et al. 2014).

The theoretical propositions for the case-study, based on the learning theories, were considered and challenged throughout the phase two data analysis. An inductive approach was used, rather than using a template based on the current literature to rigidly guide the analysis (Ritchie et al. 2014).

5.7.1 Data analysis in case-study research

Three strategies for analysing case-study data were applied in this study: employing theoretical propositions, working data from the ‘ground-up’, and examining plausible rival explanations (Yin 2014). Both a deductive and inductive analytical approach was used in the case-study. A deductive, ‘top

down' approach is where theoretical propositions or hypotheses are tested (Ritchie 2014). This is in contrast to an inductive approach, where data are worked from the 'ground up' and concepts are developed by identifying patterns in data (Ritchie et al. 2014; Yin 2014). The analysis was informed rather than reliant upon the original theoretical propositions as suggested by Yin (2014), in order to be open to new concepts or ideas emerging from data. The third strategy used was examining plausible rival explanations for the case-study findings (Yin 2014). This was achieved by exploring possible reasons which may challenge the theoretical propositions.

Three analytical techniques: pattern matching, explanation building and cross-case synthesis (Yin 2014) were used for the case-study analysis. Pattern matching is where the findings of the case-study were compared with the theoretical propositions developed at the beginning of the study (Yin 2014). Explanation building was used to build an explanation of the case, i.e. nursing students' learning of aseptic technique from the analysis of the case-study data (Yin 2014). This was achieved through an iterative process where the initial theoretical propositions were continually revised against the case-study evidence until rival explanations were no longer supported (Yin 2014). Selective bias was reduced by ensuring that the case-study did not lose focus by keeping within the case-study protocol. Rival or alternative explanations were constantly raised and challenged through the supervisory process.

Case-study data analysis was performed at two levels within each case and across cases (Yin 2014). The case-study consisted of two cases, meeting the requirements for cross case synthesis (Yin 2014). Using within and across case analysis allowed for the different communities of practice in university and clinical practice and members of those communities' perspectives to be explored. Data from the cases at the organisational level and individual level (embedded units of analysis) were analysed to explore the differences or similarities in contextual factors affecting nursing students' learning of aseptic technique.

5.7.2 Analysis of interview data

5.7.2.1 Thematic analysis

Thematic analysis was undertaken using Braun and Clarke's (2006) six step approach, which involves:

1) Familiarization with data
2) Generating initial codes
3) Searching for themes
4) Reviewing themes
5) Defining and naming themes
6) Producing the report

This framework was chosen for its systemic approach to thematic analysis. Each phase is explicitly described and was followed by the researcher to guide a recursive rather than linear analytical process (Braun and Clarke 2006). Each phase of thematic analysis will be described to illustrate how the codes and themes were developed.

5.7.2.2 Phase 1 - Familiarization with data

In phase one, the researcher listened to each audio recording immediately after the interview and interview notes were made. The researcher initially transcribed four interviews from each different type of participant. Thereafter all interviews were transcribed by an experienced transcriber before being imported into NVivo 10 for Windows. The accuracy of transcripts was checked against the audio-recordings by the researcher and any corrections made. Each interview transcript was re-read several times to become familiar with data and a memo identified possible codes.

5.7.2.3 Phase 2 - Generating initial codes

In phase two, each transcript was worked through in a systematic fashion and coded using Nvivo. Extracts were coded so that the surrounding context could be understood and no meaning was lost. A fully coded transcript can be found in Appendix 11 to demonstrate how codes were

developed. Complete coding rather than selective coding was used to code anything of relevance to the research question across the whole data set. This approach was taken to ensure that nothing was missed during the process which might become of relevance later in the analytical process (Braun and Clarke 2013).

First order coding was undertaken, where initial codes are identified (Saldana 2013). Care was taken to use participants' own words during the coding process where possible; this is known as in-vivo coding (Saldana 2013). 'Confusion' and 'doing it the right way' are examples of in-vivo codes that were derived from participants' own words. These are known as semantic or data derived codes rather than latent or researcher-derived codes (Braun and Clarke 2013). Some descriptive codes were used to summarise the prime focus of excerpts, for example 'differences or variations in aseptic technique'.

Second order coding took place where codes were continuously reviewed against the original transcript and retained, refined or removed throughout the analysis process (Saldana 2013). Ninety two initial codes were generated from the entire dataset (see Appendix 11). Four coded transcripts one for each type of participant: nurse educator, mentor, student and infection prevention and control nurse were reviewed by my two researcher supervisors. This was to ensure that the codes were appropriately assigned by the researcher and accurately represented the raw data (Fereday and Cochrane 2006). No issues were identified in the coding of data. The coding process and thematic analysis was also discussed regularly with these supervisors to provide some objectivity in the research process.

5.7.2.4 Phase 3 - Searching for themes

In this phase, similarities or patterns in codes were explored using thematic maps and tables. Codes were initially clustered into groups based on their commonality forming broader themes or categories (see Table 13). The codes were checked with the transcripts to make sure that the categories were of enough importance and magnitude to be part of a theme. The category label reflected the overall meaning of the grouped codes. Categories were then grouped into sub-themes under overarching themes

and checked for fit under these. The themes were examined to ensure that they were relevant to the research questions and to test the theoretical propositions (Yin 2014).

Table 13.Categories and codes presented under sub-themes from interview data

Sub-themes		
Confusion/Incomplete knowledge and understanding of AT	**Lack of consensus / standardisation of AT**	**Confidence/competency to practice**
Category-Confusion Codes Lack of knowledge and understanding Level of knowledge and understanding Confusion Learning / teaching AT from scratch Lack of recall and retention of learning **Category-Incomplete/lack of knowledge & understanding of aseptic technique** Codes Differences between hospital and community Stronger association of AT with wound care Controlling environmental risks Principles Procedure Importance of AT Aim of AT-Prevention of infection/ contamination/transfer of micro-organisms -Protection of health professional -Protection of patient **Category-Lack of knowledge & understanding of associated terms** Codes Differences between aseptic technique and ANTT Lack of understanding of clean, sterile and aseptic terms	**Category-Variations/differences in AT** Codes Differences or variations in AT Different terminology -made up terms/own language Variations in extra steps taken No variations in AT taught & seen in practice Difference or variations in principles -clean hand dirty hand -ANTT -others **Category-Drive for standardisation** Codes Need for a standardised approach Lack of education and training and updates in AT	**Category-Competency** Codes Level of competency Complacency Difficulties in mastering AT skills Assessment of AT competency - limited opportunity -rigour **Category-Confidence** Codes Good AT in my ward area Confidence

Table 13. Categories and codes presented under sub-themes from interview data *(continued)*

Sub-themes			
Learning the steps versus the principles	**The shaping & cascade of AT practices**	**Human, physical & Environmental Factors**	**Opportunities for learning & ability to transfer learning**
Category-Learning the steps Codes Learning or following the steps Doing it the right way Doing it the wrong way Learning the right way Learning the wrong way **Category-Learning the principles** Codes Lack of knowledge and understanding of the meaning of principles Learning and applying the same principles Adaptation to the environment or situation Adaptation in emergency situations	**Category-Cascade of practice** Codes Mentor/teacher -Level of experience -Initial training -Not up to date/teaching best practice Peers Learning environment and culture **Category-Positive behaviours** Codes Seeing or learning good practices Not influenced by others Challenging poor practices **Category-Negative behaviours** Codes Seeing or learning poor practices Picking up bad habits Following the practice of others Not following policy and guidelines Modifying practice to fit in	**Category-Human resources** Codes Too busy not enough time Group size Staffing Interruptions to AT Level of supervision and feedback **Category-Physical resources** Codes Availability and use of equipment Learning resources **Category-Physical Environment** Codes Influence of the built hospital environment	**Category-Opportunities to learn & practice in clinical practice** Codes Learning & practice opportunities in clinical placements Prior learning experiences Assessment of prior knowledge and skills Influence of patients **Category-Opportunities to learn & practice in university** Codes Learning & practice opportunities in university Loss or lack of emphasis on AT Depth and focus of learning Revisiting learning of AT **Category-Individual Learner Characteristics** Codes Learning preferences Motivation Personality of student Taking responsibility for learning **Category-Transfer of learning from university to practice** Codes Difference in reality between simulated environment and clinical practice Reliance upon learning in clinical practice Time from learning in university to opportunity to practice in clinical practice

Table 13. Categories and codes presented under sub-themes from the interview data *(continued)*

Sub-themes	
Relationships, roles and responsibilities for maintaining and improving standards of AT	**Relationships, roles and responsibilities for education and training in aseptic technique**
Category-Relationships for maintaining and improving standards Codes Relationships between staff and IPC team **Category-Roles and responsibilities for maintaining and improving standards** Codes Opportunity to review and audit AT practice Maintaining standards of AT Changing AT practices	**Category-Relationships in education and training** Codes IPC involvement or relationship with students **Category-Roles and responsibilities in education and training** Codes Relationships between NHS Trusts and universities Roles and responsibilities for teaching, education and assessment

5.7.2.5 Phase 4 -Reviewing themes

The initial categories and themes were reviewed and refined. Some category names were revised to make sure that they accurately reflected the codes underneath them. Two categories: incomplete/lack of knowledge and understanding of aseptic technique and lack of knowledge and understanding of associated terms were merged resulting in a total of 22 categories under 9 sub-themes (see Figures 7, 8 & 9). The sub-themes were reviewed against the whole data set to make sure that there were good links between them (Braun and Clarke 2006).

Figure 7 Categories associated with sub-themes: confusion, lack of consensus/standardisation and competency

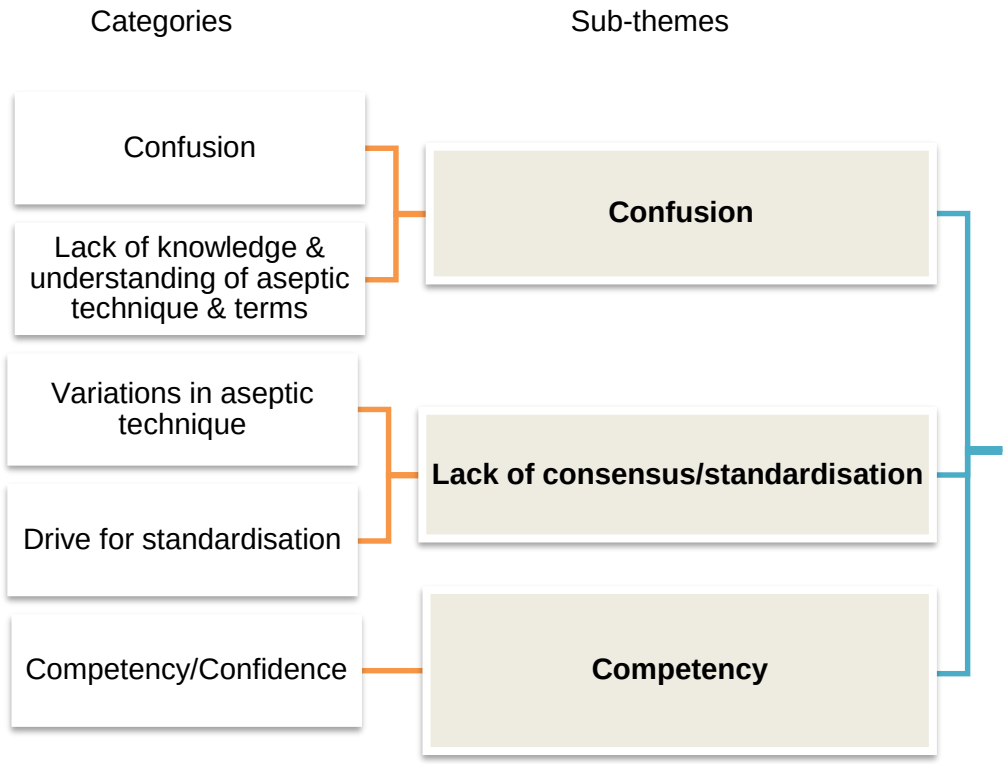


Figure 8 Categories associated with the sub-themes of learning the steps versus the principles, the shaping and cascade of practice, human, physical and environmental factors and opportunities for learning and transfer

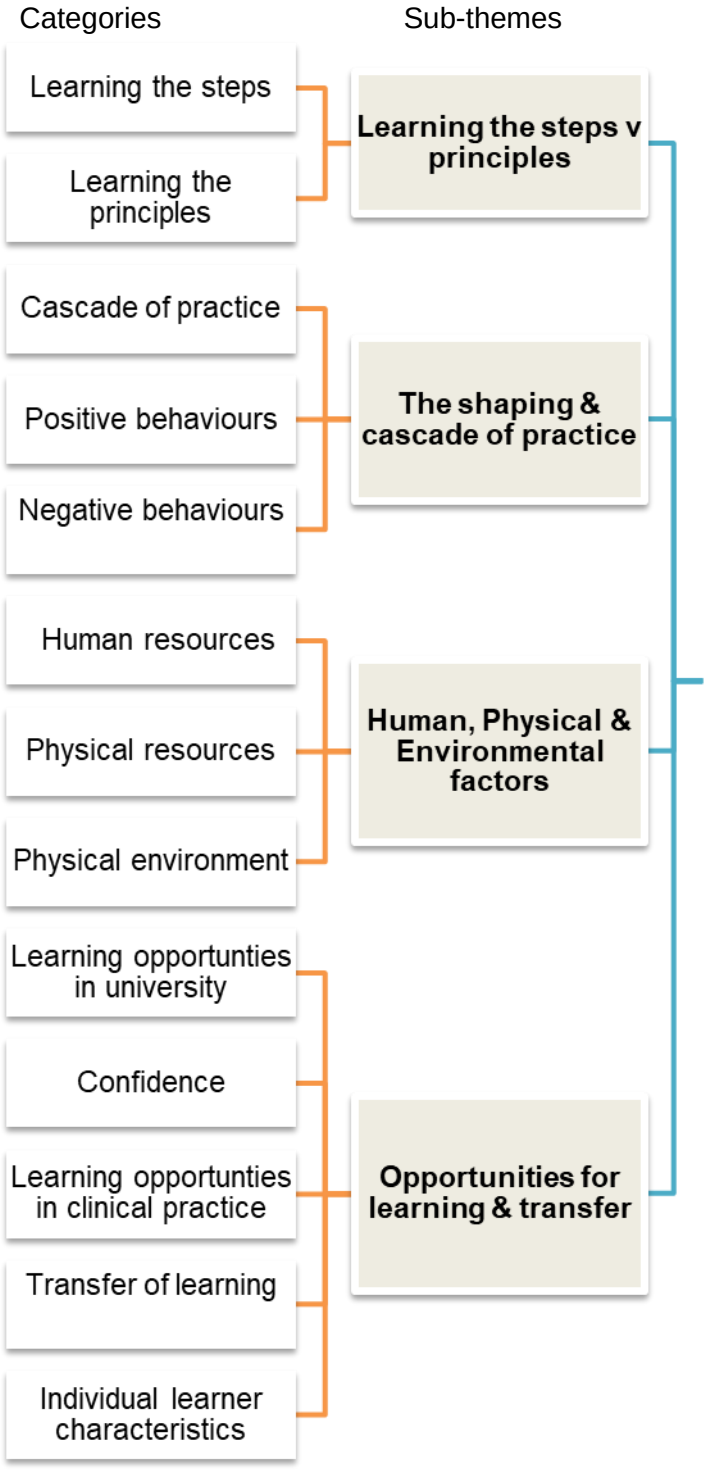
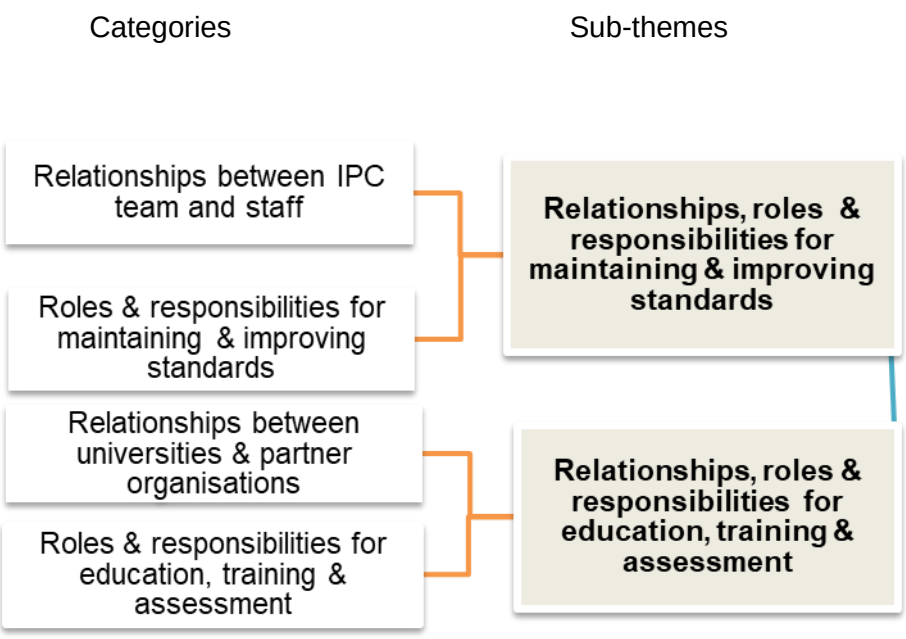


Figure 9 Categories associated with the sub-themes of relationships, roles and responsibilities for maintaining and improving standards and relationships, roles and responsibilities for education, training and assessment



The sub-themes were 'themes within themes' (Braun and Clarke, 2006 p 92) and were organised under the following three main themes:

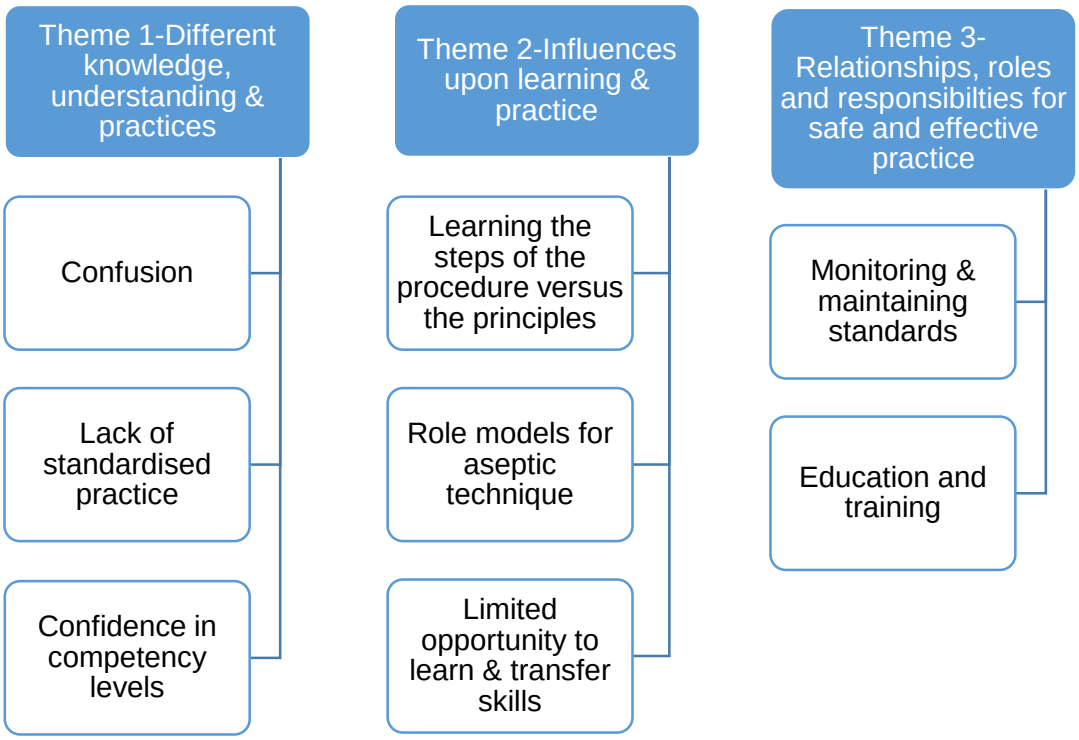
1. Different knowledge, understanding and practices of aseptic technique
2. Influences upon learning and practice of aseptic technique
3. Relationships, roles and responsibilities to support safe & effective practice

5.7.2.6 Phase 5 - Defining and naming themes

The themes, sub-themes, categories and codes underwent an iterative process where they were repeatedly revisited and checked against each other and revised accordingly. Two sub-themes 'Human, Physical and Environmental factors and 'Opportunities for Learning and Transfer' were merged into one subtheme and renamed 'Limited Opportunity to learn and transfer skills'. These sub-themes were closely related as human, physical and environmental factors were identified as limiting opportunity to learn and transfer skills. A final revision of the working titles of themes and subthemes was undertaken and are shown in Figure 10. The sub-theme 'shaping and cascade of practice' was renamed 'Role models for aseptic technique'. The name of two sub-themes 'Lack of consensus/standardisation and

'Competency' were tweaked to 'Lack of standardised practice' and 'Confidence in competency levels' respectively. The focus and boundaries of each theme were clearly defined, in terms of what the theme was or was not about, ensuring they were distinct from each other (Braun and Clarke 2006).

Figure 10 Final themes and sub-themes



5.7.3 Analysis of observation of teaching

Content analysis was used to analyse the semi-structured observation schedules. This method of analysis was chosen because it can be used with qualitative or quantitative data (Elo and Kyngas 2007). Content analysis provides an unobtrusive and objective method of analysis for textual information (Bryman 2016). The limitation of content analysis is that it can be affected by the quality of documents and can only describe what is there, not why (Bryman 2016). Content analysis was used to analyse each observation schedule, quantifying the contents in a replicable and systematic way (Bryman 2016). A quantitative approach was used to quantify the teaching and assessment methods used across observations for example, the number of different principles taught.

Qualitative content analysis classifies text into a number of categories to illustrate meaning (Hsieh and Shannon 2005). Qualitative content analysis is commonly used as a method for analysing documentary evidence (Krippendorff 1980; Elo and Kyngas 2007). An inductive approach was used initially in the content analysis of the observation field notes (Elo and Kyngas 2007). Field notes on each observation schedule were open coded as they were read and codes and categories were created. The codes and categories were then compared with the interview dataset to triangulate the evidence (Yin 2014).

5.7.4 Analysis of documentary evidence

Content analysis was used to analyse university teaching and assessment documents and NHS Trust policy documents. The purpose of documentary analysis was to support the interview and observation data (Yin 2014). Each document was read and examined in full several times. University and partnership documents varied in purpose. Common to all documents was the use of different terminology associated with aseptic technique. A decision was made to use content analysis to count the number of occurrences in which different terms associated with aseptic technique were used in documents (Bryman 2016). This was in view of Chapter 2 uncovering confusion and interchangeable use of terms. The documentary evidence was triangulated with the interview and observation data to increase the credibility of the findings and provide an holistic view of nursing students' learning of aseptic technique (Yin 2014).

5.8 Rigour and quality in mixed methods studies

The rigour and quality in each phase of the study will be discussed. Four common standards were used to demonstrate the rigour and quality of this mixed methods study: veracity, consistency, applicability and neutrality (Curry and Nunez-Smith 2015).

5.8.1 Veracity

Veracity is the 'truth' of the findings and relates to credibility in qualitative research and internal validity in quantitative research (Curry and Nunez-Smith 2015). The credibility of the case-study was enhanced by triangulation. Multiple data sources were used increasing data credibility and construct validity by bringing together different lines of inquiry (Yin 2014). Three common data sources were used: interviews, documentation and observation (Scholz and Tietje 2002; Yin 2014).

Member checking was undertaken with one of each different type of participant: student, mentor, infection prevention nurse and nurse educator to increase the credibility and dependability of the findings. This involved presenting the findings back to these participants to ensure that these reflected their views and experiences (Curry and Nunez-Smith 2015). The credibility of the case-study findings were enhanced by checking whether the findings were plausible against all data and looking for rival explanations which might account for the findings (Yin 2014). Any divergent views or findings were exposed.

Checking the coding and development of themes with two experienced researchers increased the credibility of the thematic analysis (Houghton et al, 2013) (see Section 5.7.2.3). The supervisory process facilitated discussion about coding and the development of themes and to rationalise the decisions made within the analytical process. This was considered to be part of a reflexivity strategy. The internal validity of the phase one survey was assured by the use of an expert panel in the development of the structured telephone interview schedule. The content validity of the structured telephone interview schedule was assessed by experts. Experts reviewed the questions in the structured telephone interview schedule to make sure that they reflected the concepts to be measured.

5.8.2 Consistency

Consistency refers to dependability in qualitative research and reliability in quantitative research (Curry and Nunez-Smith 2015). Dependability was ensured by having two independent and experienced researchers to review each stage of the research process as completed by the researcher. They continuously challenged the researcher's thinking and evaluated whether the findings were supported by data. At each stage of the quantitative and qualitative data analysis, the findings were discussed and reviewed with research supervisors. In qualitative data analysis, the codes, categories, subthemes and themes were constantly reviewed and revised against the interview data and discussed with the supervisors. Pilot testing the structured telephone schedule tested whether consistent information was retrieved increasing the reliability of the phase one survey (Curry and Nunez-Smith 2015). Data cleaning was performed prior to analysis of the phase one survey data. This helped to identify any erroneous data entry or missing data which might have posed a threat to the reliability of the findings.

An internal pilot of the phase two case-study procedures was conducted in the researchers' own university increasing the reliability of the case-study findings. Pilot interviews using the interview guide were conducted with a nurse educator, student and a member of staff who was a mentor (see section 5.6.8.6). The use of a case-study protocol increased the reliability of the case-study findings by guiding the data collection at the two case-study sites (Yin 2014). The procedures were clearly documented and a case-study database set up in Nvivo.

5.8.3 Applicability

Applicability is the extent to which the findings could apply in a different population or setting (Curry and Nunez-Smith 2015). Applicability is known as the transferability of findings in qualitative research and generalisability or external validity in quantitative research (Curry and Nunez-Smith 2015). The transferability of the case-study was enhanced by providing a detailed description of each case-study site. This allows for an assessment to be made as to whether the findings might be transferable in similar settings. The procedures for sampling method, participants, data collection procedures and data analysis were also reported (Curry and Nunez-Smith 2015). The external validity of the quantitative survey was increased by using a standardised approach during data collection. A detailed description of the statistical procedures was provided.

5.8.4 Neutrality

Neutrality is whether the researcher holds any a priori assumptions which might bias the interpretation of the findings (Curry and Nunez-Smith 2015). In quantitative research, this is not seen as a huge threat and is referred to as objectivity (Curry and Nunez-Smith 2015). Objectivity was demonstrated by justifying key decisions in the research process and making these transparent. For example, all important design and analysis decisions were reported so that these could be followed and understood. In qualitative research this is known as confirmability (Ritchie et al. 2014). The use of independent review or external audit of the research process as discussed earlier in relation to dependability (see 5.8.2) helped to demonstrate confirmability in this study (Curry and Nunez-Smith 2015). Other techniques included bracketing where the researcher's pre-suppositions, experiences and bias were acknowledged and these were recorded in research memos in Nvivo during the coding of case-study interviews (Curry and Nunez-Smith 2015). A reflective diary was kept throughout the research process to help demonstrate reflexivity.

5.8.5 Reflexivity

Reflexivity is the continuous process of self-evaluation and reflection upon how the researcher's position, own experiences and views might influence the research process and outcome (Bradbury-Jones 2007, Berger 2013). The rigour and credibility of the study was enhanced by taking a reflexive approach. This was achieved by acknowledging how my role as an educator might influence each step of the research process. There is recognition that the researcher is part of knowledge production and reaching complete objectivity is unachievable (Ritchie et al 2014). My beliefs about education and experiences of learning aseptic technique as a student and teaching and practising aseptic technique as a mentor and educator were recognised and reported.

There was concern about steering the interviews in a certain direction given that the researcher was an educator. The researcher's humanistic beliefs that education should be student centred and students should be partners in learning rather than recipients of learning might have had an influence upon the interviews. The interviewer had insight into the learning and teaching of aseptic technique as a practitioner and educator which was seen as beneficial in exploring this research area. A reflective diary was kept to record the researchers' decisions, feelings and judgements as part of a reflexive approach but also in providing an audit trail, increasing the confirmability and dependability of data (Houghton et al 2013).

5.9 Ethics, consent and confidentiality

5.9.1 Ethical approval

The research protocol was approved by the School of Healthcare Sciences, Research Review and Ethics Screening Committee, Cardiff University on the 4th June 2014. The School of Healthcare Sciences, Research Ethics Committee, Cardiff University gave ethical approval for the study on the 6th October 2014 (see Appendix 2). The conduct of the study was guided by research ethical frameworks (DoH 2005a; Royal College of Nursing 2009; Cardiff University 2011; Economic and Social Research Council 2012).

Following phase one of the study, minor changes were made to the research protocol and approved by the School of Healthcare Sciences Research Ethics Committee on the 18th & 25th June 2015 (see Appendix 2). One change was made following screening by an ethics committee in one university, identifying that

recruiting students from placement databases or lists held by universities would contravene the Data Protection Act 1998 (The Stationery Office 1998). The research protocol was amended to state that students would be recruited by placing an advertisement on the student website or virtual learning environment. One research and development office recommended further strategies that could be used to heighten awareness of the study in NHS Trusts. This included informing mentor links and senior sisters in NHS Trusts about the study through meetings, email or letter and the placement of posters in clinical areas.

A further amendment was instigated by me, as the researcher following selection of the phase two case-study sites. Due to the geographical location of one case-study site, phase two in-depth interviews were changed from face to face interviews to telephone interviews. After approval of these minor changes, the Heads of School of two universities selected as case-study sites were invited by email to participate in phase two of the study. Heads of School from these universities gave permission for students and HEI staff to be approached and recruited into the study. The integrated research application system (IRAS) was used to gain research and development approval from the seven NHS Trusts associated with the two universities selected as cases in the phase two case-study in order to recruit mentors and infection prevention and control nurses.

One Research and Development office requested that two additional statements were included in participant information sheets and consent forms. The first statement was that direct quotes from the interview may be used in the thesis, publications and conference presentations. The second statement was about what would happen if a serious patient safety issue or poor practice was identified during the interview. Further minor amendments were made and approved by the School of Healthcare Sciences, Research Ethics Committee, Cardiff University on the 28th July 2015 (see Appendix 2). For consistency these were added to all participant information sheets and consent forms following approval for minor amendments and all research and development offices informed. All seven NHS Trusts finally gave approval.

5.9.2 Ethical issues

It was not anticipated that many ethical concerns would arise because of the line of enquiry. There was no patient involvement in the study. Investigating nursing students' education, training and assessment in aseptic technique was not

perceived to be highly sensitive. Possible ethical concerns were that students might have perceived pressure to take part in the phase two case-study. This was minimised by selecting and conducting the phase two case-study at universities where the researcher was not employed as a lecturer. The researcher was unknown to the students and therefore they were unlikely to feel compelled to take part. Students only provided their contact details if they were willing to take part in the study. There was no coercion by the researcher for students or any other participant to take part or to continue to take part if they no longer wished to. Some infection prevention and control nurses were known to the researcher in one infection prevention team at Case-Study Site 1. The infection prevention team administrator co-ordinated and arranged interviews for those who wished to take part in the study. There was no direct contact between the researcher and infection prevention nurses initially.

5.9.3 Informed Consent

Individuals approached to be recruited to the study were informed that their participation in the study was voluntary. Participants were assured that their choice about whether to participate or not in the study would be respected. The decision made would not affect their role as health professionals or their studies as a student. The role of the researcher as a nurse lecturer was acknowledged and no students or health professionals known to the researcher were coerced to participate in the study (ESRC 2012).

All participants were informed of the purpose of the study, what the study entailed and reassured that all responses in the survey and interviews were to be made anonymous. Informed consent was gained from participants prior to the survey and interviews, through the provision of written and verbal information about the study (RCN 2011). Participant information sheets (see Appendix 3 & 7) informed participants of the potential benefits and risks of the study and about where to go for support before, during and after the study (ESRC 2012). Participants were reminded that any information provided would not affect their employment as health professionals or studies as students. Participants were asked to sign a consent form (see Appendix 3 & 7) once they had agreed to take part in the study. Participants were informed that they could withdraw from the study at any time without providing an explanation (RCN 2011). Participants who were deemed not to have capacity under the Mental Capacity Act 2005, (The Stationery Office 2007) were excluded from the study for their protection.

5.9.4 Confidentiality and anonymity

The dignity, rights and well-being of participants were protected by all data being coded to ensure anonymity and confidentiality (ESRC 2012). There was no identification of case-study sites, organisations or individuals. All data were kept in a locked cabinet or on a University password protected computer and is to be retained for fifteen years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (The Stationery Office 1998). Interviews were conducted by telephone, limiting the risk to the researcher. The next chapter will present the phase one survey findings.

Chapter 6 - Phase 1 Survey Results

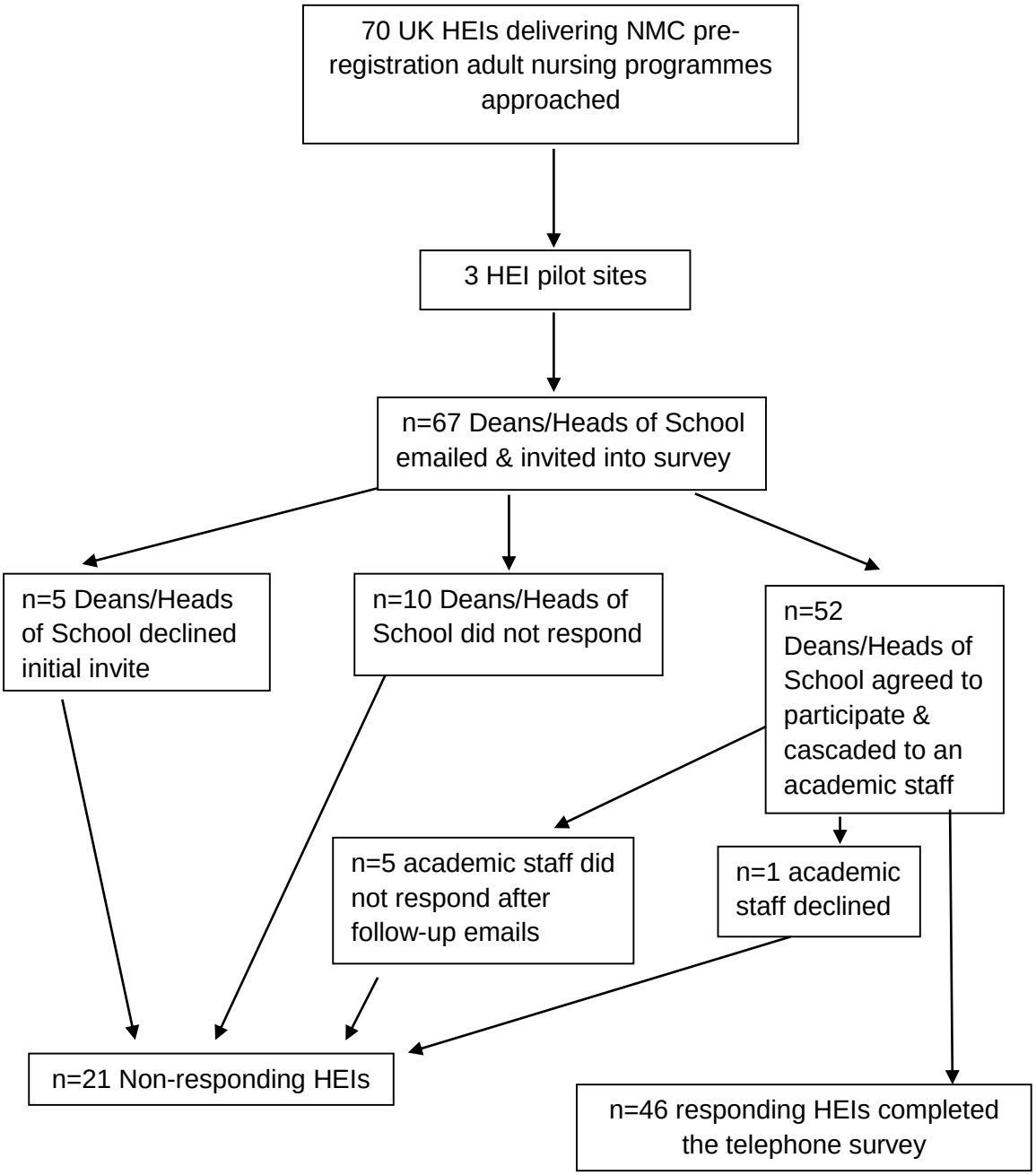
6.0 Introduction

This chapter presents the results of the phase one survey of education, training and assessment of aseptic technique in pre-registration adult nursing programmes in the UK. The response rate to the survey and respondent characteristics will be discussed first. This will be followed by a description of undergraduate, pre-registration adult nursing programmes included within the survey. The results of the survey will be presented under each research question. This will include the results of statistical tests used to look for relationships between cohort size; and number of intakes; and different teaching and assessment methods, time spent teaching, opportunity to practice, and resources. Resources and, in particular, time and more opportunities for students to practice aseptic technique were identified by nurse educators as being issues within the survey, hence the need to explore these relationships.

6.1 Response rate to the survey

The total population of UK Higher Education Institutes (HEIs) (n=70) running pre-registration adult nursing programmes were approached to take part in the survey. The recruitment process and response rate to the survey is detailed in Figure 11. The overall response rate for the survey was 70% (n=49), with representation from HEIs from all four countries of the UK: England, Wales, Scotland and Northern Ireland. Five Deans/Heads of School declined the invite, due to high workload and staffing (n=3) and to restrict access to staff and students for funded or internal research projects only (n=2). One programme lead declined to participate in the survey, as the programme team considered it inappropriate to respond to the survey as aseptic technique was taught and assessed in clinical practice only. A follow-up telephone call was made to explain that this did not exclude them from the survey and the purpose of the survey. The programme lead maintained that they, as individuals, were too busy to take part.

Figure 11 Recruitment and response rate to the phase one survey



6.2 Respondent characteristics

Different members of staff responded to the survey in different HEIs (see Table 14). The majority of respondents 65.3% (n=32) were lecturers/senior lecturers for adult nursing or clinical skills/simulation.

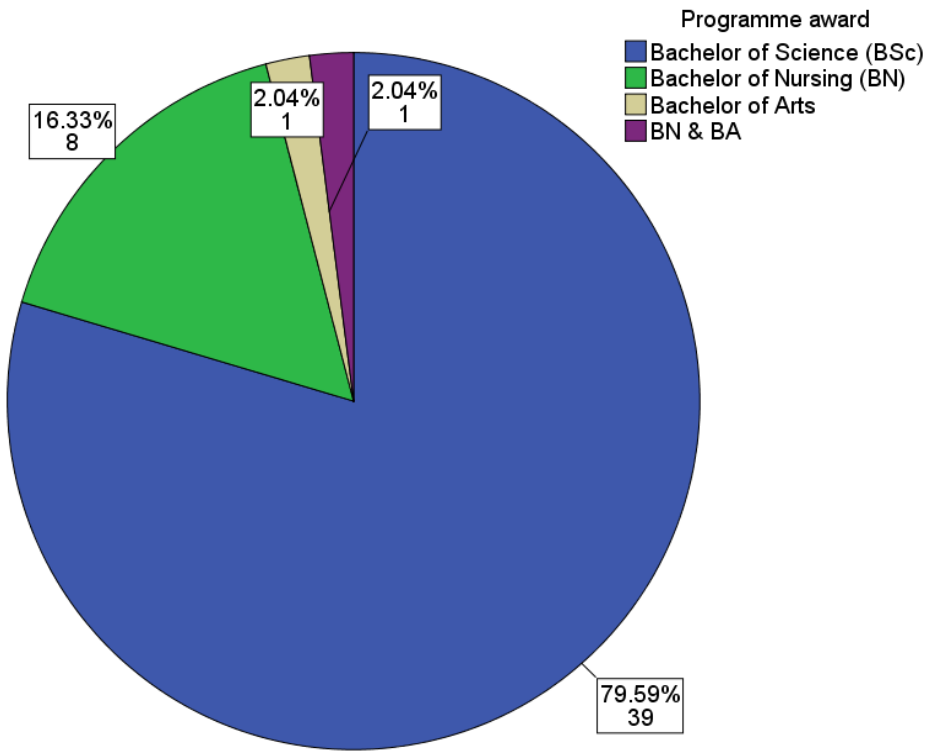
Table 14.Respondents to the survey

Role/Title	Number of responders
Heads of Department	1
Programme Leads/Directors for pre-registration programmes/adult nursing	6
Lecturers/Senior Lecturers of adult nursing	19
Senior Lecturers/Academic Leads for skills/Simulation	13
Senior Lecturers/Leads for Infection Prevention and Control	6
Professors/Associate Professors of Simulation and Clinical Skills	4
	Total =49

6.3 Description of pre-registration adult nursing programmes

A Bachelor of Science (BSc) was the most common degree award (see Figure 12).

Figure 12 Academic award for pre-registration, undergraduate programmes in the UK (n=49)



The different programme variables are presented in Table 15 below. The majority of universities, 95.6% (n=47) offered only a full-time programme. Only one university exclusively offered a part-time, distance learning programme. Most full-time

programmes 93.8% (n=45) were of three years' duration. Half of all universities had one intake 46.9% (n=23) or two intakes 51% (n=25) of adult nursing students per academic year to the programme. One university had different intakes of adult nursing students depending on location of campus.

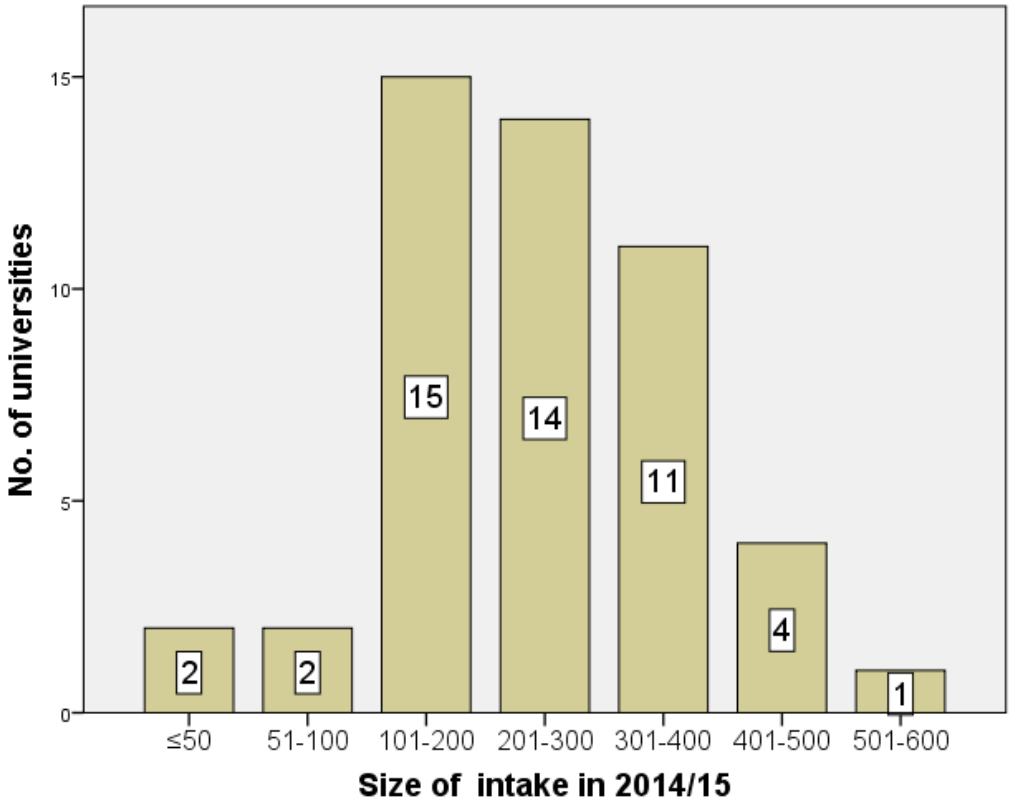
Table 15.Pre-registration adult nursing programme variables

	Programme variables	n (%)
Mode of delivery	Full-time only Part-time only Full-time & Part-time routes	47 (95.9) 1 (2.0) 1 (2.0)
	Total	49 (100%)
Duration of full-time programmes	Three years Four years Three or Four year	45 (93.8) 1 (2.1) 2 (4.2)
	Total	48 (100%)
Intakes per academic year	One Two One or Two (different across sites)	23 (46.9) 25 (51.0) 1 (2.0)
	Total	49 (100%)
Cohort size of adult nursing students 2014/15	-Small ≤100 students -Medium 101-300 students -Large ≥301 students	4 (8.2) 29 (59.2) 16 (32.7)
	Total	49 (100%)
Deliver same programme at a different location i.e. satellite site/campus	Yes No	17 (35.4) 31 (64.6)
	Total	48 (100%)
No. of sites/locations	Two Three Four	12 (70.6) 4 (23.5) 1 (5.9)
	Total	17 (100%)

In 35.4% (n=17) of universities, the same programme was delivered at more than one location. Of these universities, 70.6% (n=12) delivered the same programme at two locations. Respondents from three of these universities reported differences in resources or facilities which might influence aseptic technique teaching. Two respondents identified that there were differences in space and staffing across locations. One of these respondents described one campus having a designated skills centre and the other having a traditional skills room which was not 'like a ward'. Another respondent reported the use of different dressing packs and video demonstrations of aseptic technique across locations.

The size of intake of adult nursing students varied widely from very small intakes (≤50 students) to very large intakes (501-600 students) for the academic year 2014-15 across universities as shown in Figure 13. A larger proportion 59.2% (n=29) of universities had a medium intake of adult nursing students (101-300 students). Nearly a third, 32.7% (n=16) of universities had large intakes in excess of 301 students.

Figure 13 Size of adult nursing student intakes for academic year 2014/15 (n=49)



6.4 Results

6.4.1 Research Question 1- When is aseptic technique taught in pre-registration nursing programmes in the UK?

6.4.1.1 Aseptic technique teaching in pre-registration nursing programmes

All responding universities reported educational content with regards to aseptic technique within their programmes (see Table 16). The university providing a part-time distance learning programme was included in the analysis of when aseptic technique was taught in programmes as it was considered to have the same aim as other programmes in producing competent qualified nurses. The percentage of universities teaching aseptic technique in the second year of programmes remained almost as high as the first year.

Table 16.Teaching of aseptic technique in the programme

	Year of the Programme			
	1	2	3	4
Aseptic technique is taught	n (%)	n (%)	n (%)	n (%)
Yes	49 (100)	47 (97.9)	34 (70.8)	2 (66.7)
No	0 (0)	1 (2.1)	14 (29.2)	1 (33.7)
Total	49 (100%)	48 (100%)	48 (100%)	3 (100%)
Missing values	-	1	1	-

The pattern and total number of years in which aseptic technique was taught across three and four year programmes is shown in Table 17. The majority 69.3% (n=34) of universities, taught aseptic technique across all years of their programme. One university reported that teaching aseptic technique was confined to the first year of the programme. Few four year programmes existed, inflating the percentages shown in Table 17.

Table 17.Pattern of when aseptic technique was taught in programmes

	Three Year Programme				Four Year Programme				
Total years	**Yr 1**	**Yr 2**	**Yr 3**	n (%) of Universities	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	n (%) of Universities
1	√			1 (2.4)					0
2	√	√		11 (24.4)	√	√			1 (33.3)
3	√	√	√	33 (73.3)	√	√		√	1 (33.3)
4					√	√	√	√	1(33.3)
				45 (Missing 1)					3 (Missing 0)
				Total 46					Total 3

6.4.1.2 When aseptic technique is taught with application to clinical procedures

Table 18 shows when aseptic technique is applied to different clinical procedures across programmes. Of all clinical procedures, aseptic technique applied to wound care was most frequently reported by universities to be taught in programmes. A high number of universities reported teaching aseptic technique applied to wound care in the first year 91.8% (n=45) and second year 63.8 % (n=30). Aseptic technique applied to injection technique was most commonly taught in the first year, reported by 67.3 % (n=33) of universities. Most universities reported teaching urinary catheterisation 78.7% (n=37) and care of intravenous infusions and devices 63.8% (n=30) in the second year of their programmes.

Table 18.When aseptic technique is applied to different clinical procedures in programmes

	Year of programme			
Type of clinical procedure	Year 1 n (%)	Year 2 n (%)	Year 3 n (%)	Year 4 n (%)
Wound Care	45 (91.8)	30 (63.8)	16 (47.1)	0
Injection technique	33 (67.3)	9 (19.1)	9 (26.5)	0
Insertion of urinary catheters	12 (24.5)	37 (78.7)	9 (26.5)	0
Catheter care/management	5 (10)	0	0	0
Care of Intravenous infusion/devices	11 (22.4)	30 (63.8)	20 (58.8)	1 (50)
Medication management	9 (8.4)	4 (8.5)	7 (20.6)	0
Venepuncture	0	5 (10.6)	5 (14.7)	2 (100)
Insertion of peripheral venous catheters	0	2 (4.3)	5 (14.7)	0
Insertion/care of enteral nutrition devices	0	5 (10.6)	7 (20.6)	0
Care of tracheostomy	0	2 (4.3)	6 (17.6)	0
Other clinical procedures	2 (4.1)	4 (8.5)	6 (17.6)	1 (50)
Responses are based on the following number of universities teaching aseptic technique in year 1 n=49, year 2 n=47, year 3 n=34 year 4 n=2				

6.4.1.3. Summary

Aseptic technique was an integral part of the curriculum, taught across all years of pre-registration programmes. Aseptic technique was reported to be taught with application to specific clinical procedures across different years of the programme. Aseptic technique applied to wound care was most widely taught throughout programmes.

6.4.2 Research Question 2 - What is taught about aseptic technique in pre-registration nursing programmes in the UK?

6.4.2.1 Teaching of aseptic technique with application to clinical procedures

Five universities reported teaching students the underlying theory and principles of aseptic technique first, before applying these to specific clinical procedures in a separate practical session. Two of these universities taught only the principles of aseptic technique in the first year and applied these to clinical procedures in the second and third year of the programme.

6.4.2.2 Teaching one or two person aseptic technique when applied to wound care

The majority 59.2% (n=29) of universities taught both a one and two person technique when undertaking wound care. Over a third, 38.8% (n=19) taught only a one person technique. One university reported variance in whether a one or two person technique was taught in the programme across two locations. The

relationship between the number of intakes, size of the cohort, and whether aseptic technique was taught as a one person or two person technique was explored. The reason for this was to see if programmes with greater numbers of students were more likely to teach a two person technique rather than a one person technique. If students practice a two person technique this would allow for more students to have 'hands on' practice and be a cost effective use of resources. A cross- tabulation (see Table 19) and Fisher's exact test *(p=0.877)* confirmed that there was no significant relationship between number of student intakes and teaching aseptic technique in wound care as a one or two person technique.

Table 19.Number of intakes and teaching a one or two person technique

	When students are taught aseptic technique in wound care			
Number of student intakes	A one person technique	One & two person technique	Different across sites	Total
One	9 47.4%	13 54.8%	1 100%	23
Two	10 52.6%	16 55.2%	0 0.0%	26
Total	19 100%	29 100%	1 100%	49 100%

Cross-tabulation showed no support for a relationship between cohort size and teaching aseptic technique in wound care as a one person or a one and two person technique (see Table 20).

Table 20.Cohort size and teaching a one or two person technique

	When students are taught aseptic technique in wound care			
Cohort size	A one person technique	A one & two person technique	Different across sites	Total
Small	1 5.3%	3 10.3%	0 0.0%	4 8.2%
Medium	13 68.4%	16 55.2%	0 0.0%	29 59.2%
Large	5 26.3%	10 34.5%	1 100.0%	16 32.7%
Total	19 100.0%	29 100.0%	1 100.0%	49 100%

6.4.2.3 Guidelines used in the teaching of aseptic technique

All universities (n=49) reported the use of guidelines in the teaching of aseptic technique in their programmes (see Table 21). The Royal Marsden Clinical Nursing Procedures (Dougherty and Lister 2015) was reported to be most commonly used by 83.7% (n=41) of universities. Under half, 46.9% (n=23) of universities, stated their teaching was underpinned by the ANTT Clinical Practice Framework.

Table 21.Different guidelines in use

Type of guidelines used	**n (%) of universities**
ANTT Clinical Practice Framework	23 (46.9)
NHS Trust/hospital guidelines	20 (40.8)
Royal Marsden Clinical Nursing Procedures	41(83.7)
Clinical skills net	14 (28.6)
Other Educational texts/online resources	6 (12.2)
NICE guidelines	10(20.4)
EPIC Guidelines	5 (10.2)
RCN guidelines	2 (4.0)
Other National Guidelines	6 (12.2)
Responses n=49 universities	

Table 22 shows the number of different guidelines reported to be used by universities. A large proportion, 71% (n=35) identified the use of two or three different guidelines. The use of one guideline was reported by 14.3% (n=7) universities.

Table 22.Number of guidelines used by universities

Number of guidelines	**n (%) of universities**
1	7 (14.3)
2	18 (36.7)
3	17 (34.7)
4	2 (4.1)
5	4 (8.2)
6	1 (2.0)
	Total 49 (100%)

6.4.2.4 Key principles of aseptic technique taught

All universities (n=49) responded to a question asking what key principles of aseptic technique were taught. The possible responses to this question listed in the structured interview schedule were not read out to avoid influencing participants'

responses. A total of forty different responses were elicited from nurse educators, six of which were considered to be principles of aseptic technique (see Table 23) based on Lister's principle of protecting susceptible sites from contamination during clinical procedures (Ayliffe and English 2003) (see Chapter 2, Section 2.1). A non-touch principle was the most common principle identified as being taught by 77.6% (n=38) of universities. Identification and protection of key parts and key sites, part of ANTT was reported to be taught by 51% (n=25) of universities which almost tallies with 46.9% (n=23) of universities reporting the use of ANTT Clinical Practice Framework.

Table 23. Principles of aseptic technique identified as taught by universities

'Principles' in rank order	**n (%) of universities**
1. Non-touch principle or technique*	38 (77.6)
2. Protection of key parts and key sites*	25 (51.0)
3. Identification of key parts and key sites*	25 (51.0)
4. Only sterile items come into contact with susceptible sites	24 (49.0)
5. Preventing cross-infection	14 (28.6)
6. Asepsis is the aim for all invasive procedures*	12 (24.5)
*ANTT principles	

The remaining thirty-four responses did not resemble principles of aseptic technique, but were other aspects reported to be taught to students when teaching aseptic technique. These responses were grouped and ranked by four categories: professional standards, aseptic technique procedure related, generic infection prevention precautions/knowledge and miscellaneous (see Table 24). Hand hygiene, an infection prevention practice used during aseptic procedures, was reported to be a key principle of aseptic technique by the majority, 81.6%: (n=40), of universities. The next highest responses were the use of personal protective equipment and aseptic field management reported by 67.3% (n=33) of universities which may be considered as generic infection precautions or part of an aseptic procedure rather than principles.

Table 24. Other components of aseptic technique identified as being taught by universities

'Other taught components' in rank order by category	**n (%) of universities**
Professional standards	
Preparation (patient, environment, area or self)	12 (24.5)
Comfort	12 (24.5)
Efficient and Safe*	10 (20.4)
Documentation	4 (8.2)
Communication/Explanation to patient	4 (8.2)
Consent	2 (4.1)
Privacy and dignity	2 (4.1)
Aseptic technique procedure related	
Aseptic field management*	33 (67.3)
Disinfect/clean work surfaces	32 (65.3)
Checking sterile items are intact and in date	21 (42.9)
Risk assessment-need for surgical/standard ANTT*	10 (20.4)
Actions if you contaminate/take the wrong step	10 (20.4)
Clean hand, dirty hand	6 (12.2)
Knowing what is sterile/not sterile or what to touch/not touch	4 (8.2)
Self-awareness/Situational or conscious awareness of hands	2 (4.1)
Need for adaptation of the procedure	2 (4.1)
No adaptation of the procedure	1 (2.0)
Slow removal of dressing with bag	1 (2.0)
Wipe sachet of cleaning fluid	1 (2.0)
Use of a hand to hand, clockwise procedure	1 (2.0)
One wipe discard	1 (2.0)
Generic infection prevention precautions/knowledge	
Hand hygiene	40 (81.6)
Personal protective equipment	33 (67.3)
Safe disposal of equipment	28 (57.1)
Basic Infective precautions*	11 (22.4)
What aseptic technique is, when to use/not use it	4 (8.2)
Differentiate between clean and sterile/aseptic procedures	3 (6.1)
Knowledge & understanding of infection	3 (6.1)
Adherence to uniform and dress policy	2 (4.1)
Bare below elbows	1 (2.0)
Sterile body sites	1 (2.0)
Miscellaneous	
Use of clean technique	1 (2.0)
Follow what mentor teaches	1 (2.0)
No complacency	1 (2.0)
*ANTT principles	

The number of ANTT principles/safeguards identified by universities is shown in Table 25. Six percent (n=3) of universities could not identify any ANTT principles. This does not correspond with the 46.9% (n=23) of universities that reported the use of ANTT Clinical Practice Framework. Up to half (3-4) of the eight ANTT

principles/safeguards were identified by 32.7% (n=16) of universities. Only 12.2% (n=6) of universities identified seven to eight ANTT principles/safeguards.

Table 25.ANTT principles/safeguards identified by universities

No. of ANTT principles/safeguards	**n (%) of Universities**
0	3 (6.1)
1-2	16 (32.7)
3-4	16 (32.7)
5-6	8 (16.3)
7-8	6 (12.2)
Total	49 (100%)

A relationship between the number of universities reporting the use of ANTT guidelines and those universities identifying ANTT principle/safeguard was looked for. There was an expectation that those universities reporting the use of ANTT guidelines would identify more ANTT principle/safeguards. The number of universities reporting the use of the ANTT guidelines was cross-tabulated with those identifying each ANTT principle/safeguard (see Table 26). The table shows lower identification of the non-touch principle in universities who reported the use of ANTT guidelines than those who did not report the use of ANTT guidelines. A Chi-square test confirmed there was no statistically significant relationship between the use of ANTT guidelines and identification of the non-touch technique principle (x^2 =3.79 p=0.052). This finding suggests that identification of a non-touch principle was not exclusive to those reporting the use of ANTT guidelines.

Table 26.Use of ANTT guidelines and identification of ANTT principles/safeguards

		ANTT Guidelines used		
ANTT Principles		Yes	No	Total
Asepsis is the aim for all invasive procedures	Yes	6 26.1%	6 23.1%	12 24.5%
	No	17 73.9%	20 76.9%	37 75.5%
Total		23 100.0%	26 100.0%	49 100.0%
Risk assessment to identify level of aseptic technique needed	Yes	7 30.4%	7 26.9%	14 28.6%
	No	16 69.6%	19 73.1%	35 71.4%
Total		23 100.0%	23 100.0%	49 100.0%
Choice/need for surgical or standard ANTT	Yes	5 21.7%	5 19.2%	10 20.4%
	No	18 78.3%	21 80.8%	39 79.6%
Total		23 100.0%	26 100.0%	49 100.0%
Basic Infective precautions	Yes	5 21.7%	6 23.1%	11 22.4%
	No	18 78.3%	20 76.9%	38 77.6%
Total		23 100.0%	26 100.0%	49 100.0%
Aseptic field management	Yes	17 73.9%	16 61.5%	33 67.3%
	No	6 26.1%	10 38.%	16 32.7%
Total		23 100.0%	26 100.0%	49 100.0%
Identification of key parts and key sites	Yes	14 60.9%	11 42.3%	25 51.0%
	No	9 39.1%	15 57.7%	24 49.0%
Total		23 100.0%	26 100.0%	49 100.0%
Protection of key parts and key sites	Yes	14 60.9%	11 42.3%	25 51.0%
	No	9 39.1%	15 57.7%	24 49.0%
Total		23 100.0%	26 100.0%	49 100.0%

Table 26. Use of ANTT guidelines and identification of ANTT principles/safeguards(continued)

		ANTT Guidelines used		
ANTT Principles		Yes	No	Total
Non-touch technique	Yes	15 65.2%	23 88.5%	38 77.6%
	No	8 34.8%	3 11.5%	11 22.4%
Total		23 100.0%	26 100.0%	49 100.0%
Efficient and safe	Yes	1 4.3%	0 0.0%	48 98.0%
	No	22 95.7%	26 100.0%	1 2.0%
Total		23 100.0%	26 100.0%	49 100.0%

6.4.2.5 Summary

Aseptic technique was reported to be widely taught by universities with application to specific clinical procedures. The use of different guidelines to underpin aseptic technique teaching in university was commonplace. Almost half, 46.9% (n=23), of all universities reported the use of ANTT guidelines which had no bearing on the identification of ANTT principles/safeguards by universities. The findings suggest confusion and a lack of accuracy in the principles of aseptic technique reported to be taught by nurse educators.

6.4.3 Research question 3 - How is aseptic technique taught in pre-registration nursing programmes in the UK?

6.4.3.1 Time spent teaching aseptic technique

Table 27 shows the mean, range, median, interquartile range and total time spent in direct and indirect teaching of aseptic technique each year, across programmes (n=49). Direct teaching time was categorised as any facilitator led session where aseptic technique knowledge and skills was taught or practised. Indirect teaching time was categorised as any time where students may have the opportunity to practice aseptic technique through simulation or during optional practice time. The mean time spent directly teaching aseptic technique peaked in the first year, declining from year one to three. The opposite effect was seen for mean indirect teaching time which increased from years one to three. The total mean time spent teaching aseptic technique was highest in year two. The total teaching time ranged

from 180-3840 minutes with a mean total time of 1207.7 minutes (SD±843.9). The variance in time spent teaching aseptic technique across programmes was illustrated by the wide ranges and large standard deviations reported in Table 27.

Table 27.Time spent in teaching aseptic technique per year of the programme

	Year of programme															
	Year 1				Year 2				Year 3				Year 4			
Activity	n	Range	Mean (SD)	Median (IQR)	n	Range	Mean (SD)	Median (IQR)	n	Range	Mean (SD)	Median (IQR)	n	Range	Mean (SD)	Median (IQR)
Direct teaching time*	47	90-1260	440.1 (220.3)	405 (300-540)	45	0-1440	399.0 (308.8)	360 (180-540)	31	0-720	248.7 (205.7)	240 (60-360)	1	0	-	240
Indirect teaching time*	47	0-720	43.4 (130.4)	0 (0)	44	0-1560	141.82 (315.0)	0 (0-165)	31	0-1560	203.2 (341.8)	0 (0-360)	1	0	-	0
Total teaching time*	47	90-1680	483.8 (291.4)	480 (300-600)	45	90-1800	545.8 (410.4)	405 (240-742)	31	60-1560	451.9 (325.8)	360 (240-720)	1	0	-	240
*Time in minutes, SD- Standard deviation IQR- Interquartile Range (Q1-Q3) Year 1-1 missing & 1 N/A, Year 2-1/2 missing & 1 N/A, Year 3-3missing, Year 4-1 missing																

The existence of skewed, non-normal distributions for time spent teaching aseptic technique is shown in the histograms (Figures 14-22) below. The distribution of direct, indirect and total time in teaching aseptic technique in year one was positively skewed (see Figures 14, 15 & 16), suggesting a cluster of lower values of total time spent teaching aseptic technique in year one.

Figure 14 Direct teaching time in year one

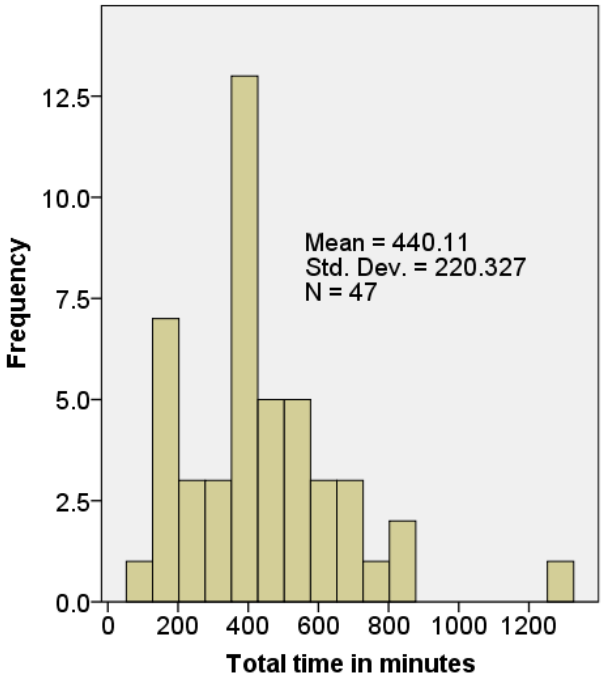


Figure 15 Indirect teaching time in year one

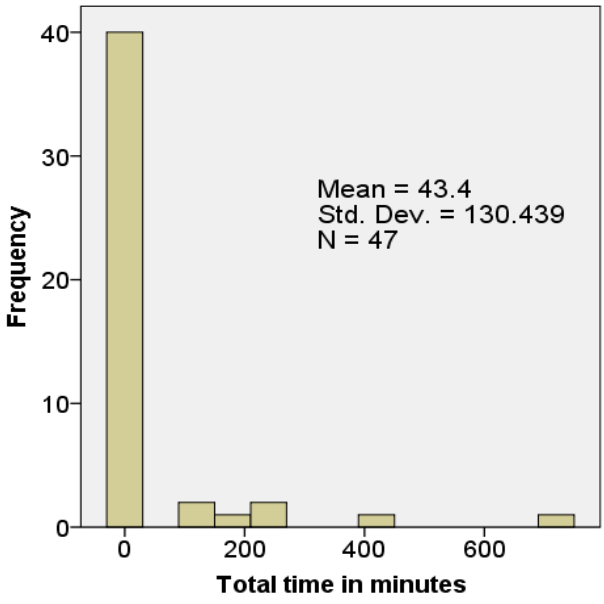
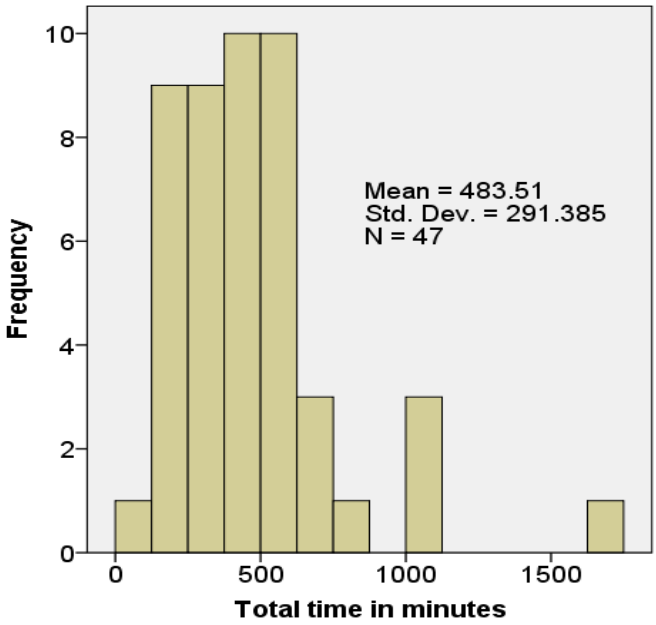


Figure 16 Total teaching time in year one



In year two, the distribution of direct, indirect and total time in teaching aseptic technique was also positively skewed (see Figures 17, 18 & 19). This suggests there was a cluster of lower values of time spent teaching aseptic technique in year two.

Figure 17 Direct teaching time in year two

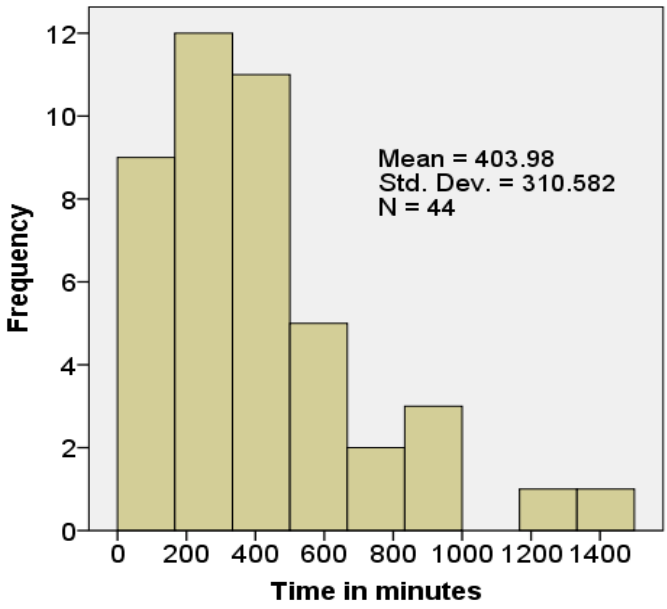


Figure 18 Indirect teaching time in year two

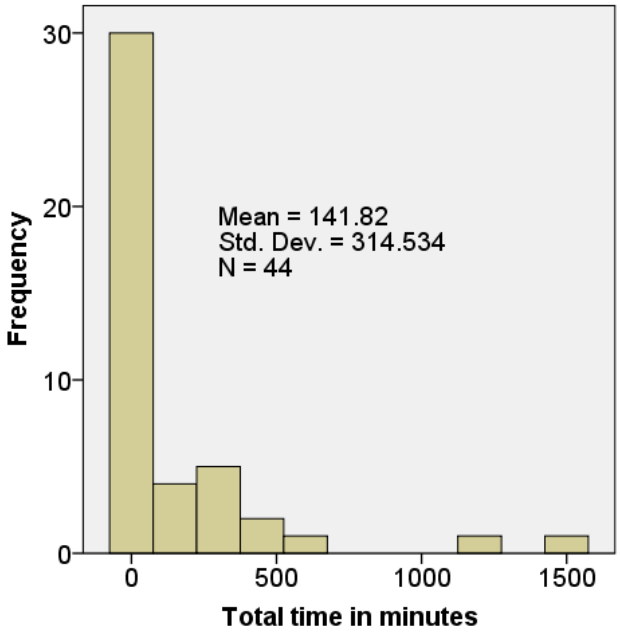
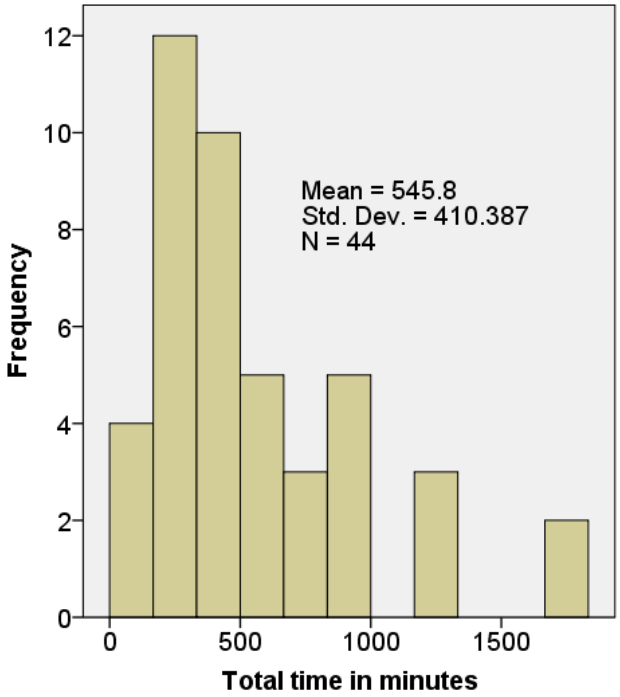


Figure 19 Total teaching time in year two



The distribution of direct, indirect and total time in teaching aseptic technique in year three was positively skewed (see Figures 20, 21 & 22). The histogram appears to

have two peaks for direct teaching of aseptic technique in year three (see Figure 20).

Figure 20 Direct teaching time in year three

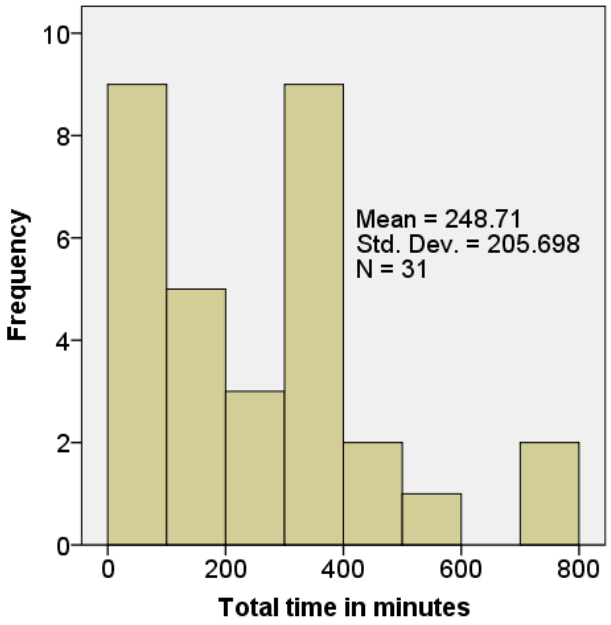


Figure 21 Indirect teaching time in year three

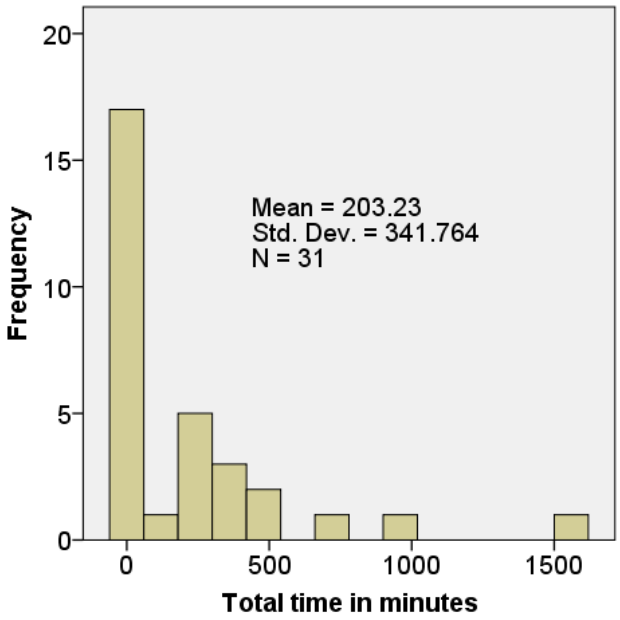
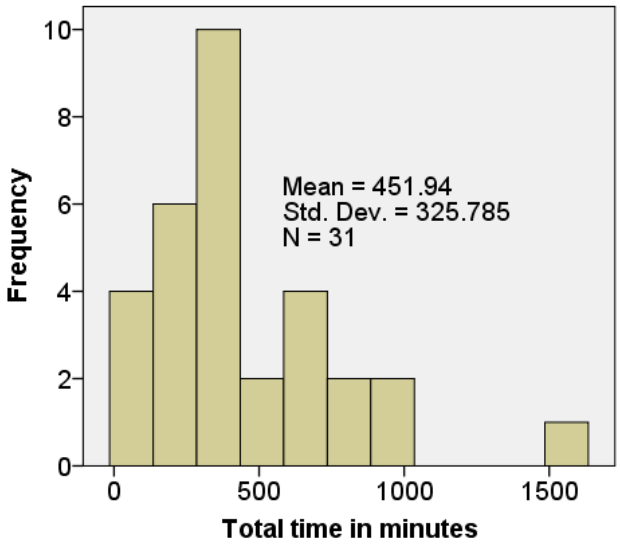


Figure 22 Total teaching time in year three



Possible relationships between number of student intakes and time spent teaching aseptic technique, cohort size and time spent teaching aseptic technique were investigated. The rationale for exploring these relationships was to determine whether course organisation and related resources made any difference. For example, whether less time was spent teaching aseptic technique in programmes with larger or a greater number of intakes than those with smaller or fewer intakes. A Mann Whitney U test found no statistical difference in time spent teaching aseptic technique in any year or in total between programmes with one or two student intakes ($p>0.05$) (see Table 28).

Table 28.Number of student intakes and total time spent teaching aseptic technique

	One intake		**Two intakes**		**Mann-Whitney U test**	
Total teaching time	*n*	*Median*	*n*	*Median*	*U*	*p-value*
Year one	21	480.00	26	450.00	299.00	0.576
Year two	20	360.00	24	465.00	258.00	0.671
Year three	12	300.00	19	360.00	141.00	0.287
Year four	1	240.00	0	0	-	-
Programme	21	960.00	26	1230.00	318.50	0.330

The median time spent teaching each year and in total was greater for small cohorts than for medium or large cohorts (see Table 29). Median time spent teaching small

and large cohorts peaked in year two but was at its highest in medium cohorts in year one. Median time spent teaching each year was more constant in medium size cohorts but total teaching time was lower than in small and large cohorts. A Kruskal Wallis test showed no statistically significant differences in total teaching time in each year and programmes across different cohort sizes ($p>0.05$) (see Table 29).

Table 29.Cohort size and time spent teaching aseptic technique

	Small cohorts		**Medium cohorts**		**Large cohorts**		**Kruskal-Wallis Test**		
Teaching time	*n*	*Median*	*n*	*Median*	*n*	*Median*	H	*df*	*p value*
Year one	3	600.00	28	450.00	16	390.00	1.77	2	0.413
Year two	3	720.00	27	360.00	14	510.00	2.76	2	0.252
Year three	3	420.00	19	360.00	9	360.00	1.04	2	0.594
Year four	0	-	0	-	1	240.00	-	-	-
Total Programme	3	1740.00	28	1080.00	16	1230.00	1.04	2	0.594

6.4.3.2 Who teaches aseptic technique?

Table 30 presents the different types of staff involved in aseptic technique teaching. Lecturers were commonly reported to be involved in aseptic technique teaching in 97.9% (n=47) of universities. In 27% (n=13) of universities, students were reported to be exclusively taught by lecturers. Infection prevention and control nurses were identified as contributing to aseptic technique teaching in 14.6% (n=7) of universities. A very small number, 8.3% (n=4), of universities reported the use of students in peer teaching. This is lower than the 32.7% (n=16) of universities who reported the use of peer teaching when asked about learning/teaching methods (see Section 6.4.3.4). This may suggest that this question was conceived to be about the different types of staff involved in teaching leading to errors in reporting about peer teaching.

Table 30.Different types of staff involved in teaching aseptic technique

Type of Role (contract)	**n (%) of universities**
HEI lecturers (100% university)	47 (97.9)
Skills facilitators/tutors (40-60% university)	9 (18.8)
Senior /Associate lecturers/Graduate tutors (40-60% university)	3 (6.3)
Clinical educators/demonstrators (100% NHS trust buy in)	3 (6.3)
Practice educators (50% university/50% NHS trust)	12 (25)
Infection prevention and control nurses (100% NHS trust)	7 (14.6)
Other clinicians/practice staff (100% NHS trust)	12 (25)
Students (peer teaching)	4 (8.3)
Other	7 (4.6)
Responses n=48 (missing 1-non-taught programme)	

Programmes with larger cohorts and a greater number of intakes might have influenced who was teaching aseptic technique in university. Cross-tabulations were used to investigate whether there were relationships. The number of student intakes was cross-tabulated with the different types of individuals involved in the delivery of teaching and showed no evidence of a relationship (see Table 31).

Table 31.Number of student intakes and who teaches aseptic technique in university

		Who teaches aseptic technique in university?		
		Lecturers		
		Yes	No	Total
No. of intakes	One	22 46.8%	0 0.0%	22 45.8%
	Two	25 53.7%	1 100.0%	26 54.2%
Total		47 100.0%	1 100.0%	48 100.0%
		Senior/associate lecturers/graduate tutors		
		Yes	No	Total
No. of intakes	One	1 33.3%	21 46.7%	22 45.8%
	Two	2 66.7%	24 53.3%	26 54.2%
Total		3 100.0%	45 100.0%	48 100%
		Clinical educators/demonstrators		
		Yes	No	Total
No. of intakes	One	0 0.0%	22 48.9%	22
	Two	3 100.0%	23 51.1%	26
Total		3 100%	45 100%	48 100.0%

Table 31. Number of student intakes and who teaches aseptic technique in university (Continued)

		Practice educators		
		Yes	No	Total
No. of intakes	One	7 58.3%	15 41.7%	22 45.8%
	Two	5 41.7%	21 58.3%	26 54.2%
Total		12 100.0%	36 100.0%	48 100.0%
		Skills tutors/facilitators		
		Yes	No	Total
No. of intakes	One	3 33.3%	19 48.7%	22
	Two	6 66.7%	20 51.7%	26
Total		9 100.0%	39 100.0%	48 100.0%
		Infection prevention and control nurses		
		Yes	No	Total
No. of intakes	One	4 57.1%	18 43.9%	22 45.8%
	Two	3 42.9%	23 56.1%	26 54.2%
Total		7 100.0%	41 100%	48 100.0%
		Students (peer teaching)		
		Yes	No	Total
No. of intakes	One	1 25.0%	21 47.7%	22 45.8%
	Two	3 75.0%	23 52.3%	25 54.2%
Total		4 100.0%	44 100%	48 100%
		Clinicians/Practice staff		
		Yes	No	Total
No. of intakes	One	3 25%	19 52.8%	22 45.8%
	Two	9 75%	17 47.2%	26 54.2%
Total		12 100.0%	26 100.0%	48 100%
		Other persons		
		Yes	No	Total
No. of intakes	One	2 28.6%	20 48.8%	22 45.8%
	Two	5 71.4%	21 51.2%	26 54.2%
Total		7 100.0%	41 100.0%	48 100.0%

Cohort size was cross-tabulated with the different types of individuals involved in aseptic technique teaching (see Table 32). The cross-tabulation suggested there might be greater input of infection prevention nurses in small or medium size cohorts than larger cohorts. A Mantel Haenszel test for trend established a statistically significant relationship between cohort size and involvement of infection prevention and control nurses in aseptic technique teaching (p=0.011).

Table 32.Cohort size and who teaches aseptic technique in university

		Who teaches aseptic technique in university?		
		HEI lecturers		
		Yes	No	Total
Cohort size	Small	4 8.5%	0 0.0%	4 8.3%
	Medium	28 59.6%	0 0.0%	28 58.3%
	Large	15 31.9%	1 100.0%	16 33.3%
Total		47 100%	1 100.0%	48 100.0%
		Senior/associate/graduate lecturers		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 8.9%	4 8.3%
	Medium	1 33.3%	27 60.0%	28 58.3%
	Large	2 66.7%	14 31.1%	16 33.3%
Total		3 100.0%	45 100.0%	48 100.0%
		Clinical educators/demonstrators		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 8.9%	4 8.3%
	Medium	1 33.3%	27 60.0%	28 58.3%
	Large	2 66.7%	14 31.1%	16 33.3%
Total		3 100.0%	45 100.0%	48 100.0%
		Practice educators/clinical teachers		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 11.1%	4 8.3%
	Medium	8 66.7%	20 55.6%	28 58.3%
	Large	4 33.3%	12 33.3%	16 33.3%
Total		12 100%	36 100.0%	48 100.0%

Table 32. Cohort size and who teaches aseptic technique in university (continued)

		Skills tutors/facilitators		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 10.3%	4 8.3%
	Medium	7 77.8%	21 53.8%	28 58.3%
	Large	2 22.2%	14 35.9%	16 33.3%
Total		9 100.0%	39 100.0%	48 100.0%
		Infection prevention and control nurses		
		Yes	No	Total
Cohort size	Small	2 28.6%	2 4.9%	4 8.3%
	Medium	5 71.4%	23 56.1%	28 58.3%
	Large	0 0.0%	16 39.0%	16 33.3%
Total		7 100.0%	41 100.0%	48 100.0%
		Students (peer teaching)		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 9.1%	4 8.3%
	Medium	1 25.0%	27 61.4%	28 58.3%
	Large	3 75.0%	13 29.5%	16 33.3%
Total		4 100.0%	44 100.0%	48 100.0%
		Clinicians/Practice staff		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 11.1%	4 8.3%
	Medium	7 58.3%	21 58.3%	28 58.3%
	Large	5 41.7%	11 30.6%	16 33.3%
Total		12 100.0%	36 100.0%	48 100.0%
		Other persons		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 9.8%	4 8.3%
	Medium	4 57.1%	24 58.5%	28 58.3%
	Large	3 42.9%	13 31.7%	16 33.3%
Total		7 100.0%	41 100.0%	48 100.0%

6.4.3.3 Preparation for taught sessions

The majority 93.8% (n=45/48) of universities with a taught programme, expected students to prepare before aseptic technique sessions. Table 33 below identifies the different types of pre-session learning resources reported to be in use. In 93.3% (n=42) of universities students were expected to do pre-reading. Over three quarters 77.8% (n=35) expected students to access and complete e-learning resources.

Table 33.Pre-session learning resources for students

Pre-session learning resource	**n (%) of universities**
E-learning	35 (77.8)
View video demonstration	29 (64.4)
Pre-reading	42 (93.3)
Quiz	8 (17.8)
Guided study/workbook	7 (15.6)
Access links/websites	8 (17.8)
Other resources	5 (11.1)
Response n=45 universities *(1-non-taught programme, 3-no expectations for pre-session preparation)*	

Cross-tabulations were performed to see if there was greater expectation to prepare for taught sessions in programmes with more student intakes and larger cohort size compared with programmes with fewer students. The number of student intakes was cross-tabulated with whether students were expected to prepare before taught aseptic technique sessions; this suggested no relationship existed (see Table 34).

Table 34.Number of student intakes and preparation for taught sessions

	Do students have to prepare before taught aseptic technique sessions?		
Number of student intakes	Yes	No	Total
One	21 46.7%	1 33.3%	22 45.8%
Two	24 53.3%	2 66.7%	26 54.2%
Total	45 100%	3 100%	48 100%

A cross-tabulation (see Table 35) indicated no relationship between cohort size and preparation for taught sessions.

Table 35.Cohort size and preparation for taught sessions

	Do students have to prepare before taught aseptic technique sessions?		
Cohort size	Yes	No	Total
Small	4 8.9%	0 0.0%	4 8.3%
Medium	25 55.6%	3 100.0%	28 58.3%
Large	16 35.6%	0 0.0%	16 33.3%
Total	45 100.0%	3 100.0%	48 100.0%

6.4.3.4 Learning/teaching methods

The different learning/ teaching methods used to teach aseptic technique were identified by all 49 universities (see Table 36). The majority 85.7% (n=42) of universities reported the use of simulation. Provision of a real time practical demonstration or video demonstration of aseptic technique was reported by 89.9% (n=44) and 75.5% (n=37) respectively. A high percentage, 77.6 % (n=38), of universities delivered the theory behind aseptic technique through lectures.

Table 36.Different learning/teaching methods used by universities

Learning & teaching methods	**n (%) of universities**
Lectures	38 (77.6)
Practical sessions	16 (32.7)
Simulation	42 (85.7)
Real time practical demonstration	44 (89.9)
Video demonstration	37 (75.5)
Skills stations	20 (40.8)
Peer teaching	16 (32.7)
Online/E-learning	39 (79.6)
Other	2 (4.1)
Responses are based on n=49 universities	

Videos and e-learning were commonly used: 75.5% (n=37) and 79.6% (n=39) of universities respectively. Table 37 shows that 43.6% (n=17) of universities used commercial e-learning packages.

Table 37.Different types of e-learning resources in use

Type of e-learning resource	n (%) of Universities
Commercial	17 (43.6)
National (free)	7 (17.9)
In-house	7 (17.9)
Both commercial & In-house	1 (2.6)
Open access	3 (7.7)
Unknown	4 (10.3)
	Total =39

Any relationships between the number of student intakes, cohort size, and different learning/teaching methods were looked for to see if programmes with larger numbers of students and more intakes influenced the learning/teaching methods used. Number of student intakes was cross-tabulated with the different learning/teaching methods used by universities (see Table 38). The use of skills stations appeared to be higher in programmes with one student intake. A Chi square test confirmed a statistical significant relationship between the number of intakes and reported use of skills stations (x^2 (1) =4.43 p=0.035), with Cramer's V= 0.301 showing a moderate effect size. The number of intakes was found to influence the use of skills stations, with programmes with one intake more likely to use skills stations than those with two intakes.

Table 38.Number of student intakes and use of different learning/teaching methods

		Type of learning/teaching method		
		Lectures		
		Yes	No	Total
No. of intakes	One	16 42.1%	7 63.6%	23 46.9%
	Two	22 57.9%	4 36.4%	26 53.1%
Total		38 100%	11 100%	49 100%
		Simulation/Simulated scenarios		
		Yes	No	Total
No. of intakes	One	21 50.0%	2 28.6%	23 46.9%
	Two	21 50.0%	5 71.4%	26 53.1%
Total		42 100%	7 100%	49 100%
		Practical demonstrations		
		Yes	No	Total
No. of intakes	One	20 45.5%	3 60.0%	23 46.9%
	Two	24 54.5%	2 40.0%	26 53.1%
Total		44 100%	5 100%	49 100%
		Skills stations		
		Yes	No	Total
No. of intakes	One	13 65.0%	10 34.5%	23 46.9%
	Two	7 35.0%	19 65.5%	26 53.1%
Total		20 100%	29 100%	49 100%
		Practical sessions		
		Yes	No	Total
No. of intakes	One	22 46.8%	1 50.0%	23 46.9%
	Two	25 53.2%	1 50.0%	26 53.1%
Total		47 100%	2 100%	49 100%
		Peer teaching		
		Yes	No	Total
No. of intakes	One	6 37.5%	17 51.5%	23 46.9%
	Two	10 62.5%	16 48.5%	26 53.1%
Total		16 100%	33 100%	49 100%

Table 38. Number of student intakes and use of different learning/teaching methods (continued)

		E-learning		
		Yes	No	Total
No. of intakes	One	21 53.8%	2 20.0%	23 46.9%
	Two	18 46.2%	8 80.0%	26 53.1%
Total		39 100%	10 100%	49 100%
		Video demonstrations		
		Yes	No	Total
No. of intakes	One	17 45.9%	6 50.0%	23 46.9%
	Two	20 54.1%	6 50.0%	26 53.1%
Total		37 100%	12 100%	49 100%
		Other Methods		
		Yes	No	Total
No. of intakes	One	1 50.0%	22 46.8%	23 46.9%
	Two	1 50.0%	25 53.25	26 53.1%
Total		2 100%	47 100%	49 100%

A cross-tabulation indicated no association between cohort size and different types of learning/teaching methods: lectures, simulation, practical real time demonstrations, skills stations, practical sessions, peer teaching, e-learning, and other learning/teaching methods (see Table 39).

Table 39.Cohort size and different learning/teaching methods

		Type of learning/teaching method		
		Lectures		
		Yes	No	Total
Cohort size	Small	4 10.5%	0 0.0%	4 8.2%
	Medium	21 55.3%	8 72.7%	29 59.2%
	Large	13 34.2%	3 27.3%	16 32.7%
Total		38 100.0%	11 100.0%	49 100.0%
		Simulation/Simulated scenarios		
		Yes	No	Total
Cohort size	Small	4 9.5%	0 0.0%	4 8.2%
	Medium	25 59.5%	4 57.1%	29 59.2%
	Large	13 31.0%	3 42.9%	16 32.7%
Total		42 100.0%	7 100.0%	49 100.0%
		Practical demonstrations		
		Yes	No	Total
Cohort size	Small	4 9.1%	0 0.0%	4 8.2%
	Medium	25 56.8%	4 80.0%	29 59.2%
	Large	15 34.1%	1 20.0%	16 32.7%
Total		44 100.0%	5 100.0%	49 100.0%
		Skills stations		
		Yes	No	Total
Cohort size	Small	2 10.0%	2 6.9%	4 8.2%
	Medium	11 55.0%	18 62.1%	29 59.2%
	Large	7 35.0%	9 31.0%	16 32.7%
Total		20 100.0%	29 100.0%	49 100.0%

Table 39. Cohort size and different learning/teaching methods (continued)

		Practical sessions		
		Yes	No	Total
Cohort size	Small	4 8.5%	0 0.0%	4 8.2%
	Medium	27 57.4%	2 100.0%	29 59.2%
	Large	16 34.0%	0 0.0%	16 32.7%
Total		47 100.0%	2 100.0%	49 100.0%
		Peer teaching		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 12.1%	4 8.2%
	Medium	10 62.5%	19 57.6%	29 59.2%
	Large	6 37.5%	10 30.3%	16 32.7%
Total		16 100.0%	33 100.0%	49 100.0%
		E-learning		
		Yes	No	Total
Cohort size	Small	4 10.3%	0 0.0%	4 8.2%
	Medium	23 59.0%	6 60.0%	29 59.2%
	Large	12 30.8%	4 40.0%	16 32.7%
Total		39 100.0%	10 100.0%	49 100.0%
		Video demonstrations		
		Yes	No	Total
Cohort size	Small	2 5.4%	2 16.7%	4 8.2%
	Medium	23 62.2%	6 50.0%	29 59.2%
	Large	12 32.4%	4 33.3%	16 32.7%
Total		37 100.0%	12 100.0%	49 100.0%
		Other Methods		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 8.5%	4 8.2%
	Medium	1 50.0%	28 59.6%	29 59.2%
	Large	1 50.0%	15 31.9%	16 32.7%
Total		2 100.0%	47 100.0%	49 100.0%

6.4.3.5 Opportunities for students to practice aseptic technique

Of the 48 universities who provide a taught programme, 93.8% (n=45) reported that all students have an opportunity to practice aseptic technique in university. One of these universities reported students practice aseptic technique applied to injection technique but not wound care. Relationships were looked for between number of intakes, and cohort size, and opportunity for all students to practice aseptic technique in university. The rationale for this was to explore whether programmes with larger numbers of students might have had less opportunity for all students to practice aseptic technique than those with smaller numbers. The cross-tabulation (see Table 40) indicated no relationship between number of student intakes and opportunity for all students to practice aseptic technique in university.

Table 40.Number of intakes and opportunity to practice aseptic technique in university

	Do all students practice aseptic technique in university?			
Number of student intakes	Yes	No	Injection technique only	Total
One	21 46.7%	1 2.1%	0 0.0%	22 45.8%
Two	24 53.3%	1 2.1%	1 100.0%	26 54.2%
Total	45 100.0%	2 100.0%	1 100.0%	48 100%

No association between cohort size and opportunity for all students to practice aseptic technique in university was evident using a cross-tabulation (see Table 41).

Table 41.Cohort size and opportunity to practice aseptic technique in university

	Do all students practice aseptic technique in university?			
Cohort size	Yes	No	Injection technique only	Total
Small	4 8.9%	0 0.0%	0 0.0%	4 8.3%
Medium	25 55.6%	2 100.0%	1 100.0%	28 58.3%
Large	16 35.6%	0 0.0%	0 0.0%	16 33.3%
	45 100.0%	2 100.0%	1 100.0%	48 100.0%

The opportunity for students to practice aseptic technique outside of teaching time, in addition to formal teaching hours was offered by 68.8% (n=33) of universities. Relationships were looked for between number of intakes, and cohort size, and opportunity to practice outside of teaching time to establish whether there was greater opportunity in programmes with larger student numbers. A cross-tabulation (see Table 42) showed that students had greater opportunity to practice aseptic technique outside of teaching time in programmes with two intakes than those with one intake. A Chi square test found no statistically significant association between the number of student intakes and opportunity to practice aseptic technique outside of teaching time ($x^2(1) = 1.76$ $p=0.184$).

Table 42.Number of student intakes and opportunity to practice aseptic technique outside of teaching time

	Do all students have opportunity to practice aseptic technique outside of teaching time?		
Number of student intakes	Yes	No	Total
One	13 39.4%	9 60.0%	22 45.8%
Two	20 60.6%	6 40.0%	26 54.2%
Total	33 100.0%	15 100.0%	48 100.0%

A cross-tabulation (see Table 43) suggested there was no relationship between cohort size and opportunity to practice aseptic technique outside of teaching time.

Table 43.Cohort size and opportunity to practice aseptic technique outside teaching time

	Do all students have opportunity to practice aseptic technique outside of teaching time?		
Cohort size	Yes	No	Total
Small	3 9.1%	1 6.7%	4 8.3%
Medium	19 57.6%	9 60.0%	28 58.3%
Large	11 33.3%	5 33.3%	16 33.3%
Total	33 100.0%	15 100.0%	48 100.0%

6.4.3.6 How do students receive feedback on their practice of aseptic technique?

The different methods of feedback provided upon students' performance of aseptic technique is shown in Table 44. All, 100% (n=48), of universities with a taught

programme reported students receiving facilitator feedback. A high percentage of universities reported the use of peer feedback 81.3% (n=39) and self-assessment/reflection 75% (n=36).

Table 44.Methods of feedback on students' performance of aseptic technique

Methods of feedback	**n (%) of universities**
Facilitator	48 (100)
Peer	39 (81.3)
Self-assessment/reflection	36 (75)
Video	10 (20.8%)
Service user	4 (8.3)
Simulated patient	8 (16.7)
Other	2 (4.2)
Responses are based on n=48 universities	

The method of feedback upon students' performance could have been influenced by the number of students on programmes. Relationships between number of intakes, and cohort size, and different methods of feedback were therefore investigated. A cross tabulation (see Table 45) showed no association between number of student intakes and different methods of feedback upon performance: self-assessment/reflection, peer feedback, client/service user feedback, simulated patient/actor feedback and other feedback.

Table 45.Number of student intakes and different methods of feedback

		Methods of feedback		
		Self-assessment/reflection		
		Yes	No	Total
No. of intakes	One	16 44.4%	6 50.0%	22 45.8%
	Two	20 55.6%	6 50.0%	26 54.2%
Total		36 100%	12 100%	48 100%
		Facilitator		
		Yes	No	
No. of intakes	One	22 45.8%	-	22 45.8%
	Two	26 54.2%	-	26 54.2%
Total		48 100%	-	48 100%
		Peer		
		Yes	No	
No. of intakes	One	18 46.2%	4 44.4%	22 45.8%
	Two	21 53.8%	5 55.6%	26 54.2%
Total		39 100%	9 100%	48 100%
		Client/service user		
		Yes	No	
No. of intakes	One	1 25.0%	21 47.7%	22 45.8%
	Two	3 75.0%	23 53.3%	26 54.2%
Total		4 100%	44 100%	48 100%
No. of intakes	One	1 25.0%	21 47.7%	22 45.8%
		Simulated patient/actor		
		Yes	No	
No. of intakes	One	5 62.5%	17 42.5%	22 45.8%
	Two	3 37.5%	23 47.5%	26 54.2%
Total		8 100%	40 100%	48 100%
		Other		
		Yes	No	
No. of intakes	One	1 50%	21 45.7%	22 45.8%
	Two	1 50%	25 54.3%	26 54.2%
Total		2 100%	46 100%	48 100%

Cohort size was cross tabulated with use of different methods of feedback on practice of aseptic technique in university and showed no evidence of a relationship (see Table 46).

Table 46.Cohort size and different methods of feedback on performance

		Methods of feedback		
		Self-assessment/reflection		
		Yes	No	Total
Cohort size	Small	4 11.1%	0 0.0%	4 8.3%
	Medium	19 52.8%	9 75.0%	28 58.3%
	Large	13 36.1%	3 25.0%	16 33.3%
Total		36 100.0%	12 100.0%	48 100.0%
		Facilitator		
		Yes	No	Total
Cohort size	Small	4 8.3%	0	4 8.3%
	Medium	28 58.3%	0	28 58.3%
	Large	16 33.3%	0	16 33.3%
Total		48 100.0%	0	48 100.0%
		Peer		
		Yes	No	Total
Cohort size	Small	4 10.3%	0 0.0%	4 8.3%
	Medium	21 53.8%	7 77.8%	28 58.3%
	Large	14 35.9%	2 22.2%	16 33.3%
Total		39 100.0%	9 100.0%	48 100.0%
		Client/Service user		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 9.1%	4 8.3%
	Medium	3 75.0%	25 56.8%	28 58.3%
	Large	1 25.0%	15 34.1%	16 33.3%
Total		4 100.0%	44 100.0%	48 100.0%

Table 46. Cohort size and different methods of feedback on performance (continued)

		Simulated patient/actor		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 10.0%	4 8.3%
	Medium	5 62.5%	23 57.7%	28 58.3%
	Large	3 37.5%	13 37.5%	16 33.3%
Total		8 100.0%	40 100.0%	48 100.0%
		Other		
		Yes	No	Total
Cohort size	Small	0 0.0%	4 8.7%	4 8.3%
	Medium	2 100.0%	26 56.5%	28 58.3%
	Large	0 0.0%	16 33.3%	16 33.3%
Total		2 100.0%	46 100.0%	48 100.0%

Students were video recorded in the practice of aseptic technique in 20.8% of universities (n=10) for the purpose of reviewing their performance. Of these, eight universities reported students being able to review these in teaching time only and two universities, both in and outside of teaching time. Seven universities reviewed the recordings in small groups (1-10). Service user or simulated patient feedback was less common. Students might have been expected to be recorded in programmes with larger numbers of students than in smaller programmes where providing individualised facilitator feedback might more difficult. A cross-tabulation (see Table 47) suggested a relationship between the number of student intakes and recording practice of aseptic technique but this did not reach statistical significance (p=0.084) using a Fisher's exact test.

Table 47.Number of student intakes and recording practice of aseptic technique

	Are students videoed in the practice of aseptic technique?		
Number of student intakes	Yes	No	Total
One	2 20.0.%	20 52.6%	22 45.8%
Two	8 80.0%	18 47.4%	26 54.2%
Total	10 100.0%	38 100.0%	48 100%

Cohort size was cross-tabulated with recording of students' performance in aseptic technique and suggested that a relationship was unlikely (see Table 48).

Table 48.Cohort size and recording practice of aseptic technique in university

	Are students videoed in the practice of aseptic technique?		
Cohort size	Yes	No	Total
Small	0 0.0%	4 10.5%	4 8.3%
Medium	6 60.0%	22 57.9%	28 58.3%
Large	4 40.0%	12 31.6%	16 33.3%
Total	10 100.0%	38 100.0%	48 100.0%

6.4.3.7 Proposed changes to the way aseptic technique could be taught

Forty six universities with a taught programme excluding the pilot sites responded to a question about how they might change the way aseptic technique was taught or assessed. The opportunity to identify three changes that could be made to the way aseptic technique is taught or assessed was taken by 60.9% (n=28) universities (see Table 49). Two changes were offered by 28.3% (n=13) of universities and one change by 10.9% (n=5) of universities. More teaching time 26.1% (n=12) and practice of aseptic technique 19.6% (n=9) were the most common recommendations for change to the way aseptic technique is taught.

Table 49.Proposed changes to the way aseptic technique is taught

Suggestions for change	No (%) of universities
Greater resources	
More time	12 (26.1)
More practice of aseptic technique	9 (19.6)
Smaller groups	4 (8.7)
Better teaching resources/equipment	4 (8.7)
Greater input from clinical staff	3 (6.5)
More facilitators	3 (6.5)
Move coverage in different years of the programme	3 (6.5)
Innovation/Development of learning & teaching resources	2 (6.5)
The way aseptic technique is taught	
Greater importance/emphasis placed on aseptic technique	6 (13.0)
Increase standards & rigour/standardised approach	6 (13.0)
More simulation/use of simulated scenarios	5 (10.9)
Greater use of service users/simulated patients	5 (10.9)
More emphasis on the underlying principles	3 (6.5)
Introduce peer teaching	2 (4.3)

6.4.3.8 Summary

Wide variation in the time spent teaching aseptic technique was reported across programmes. No significant association was found between the number of intakes or size of cohort and total time spent teaching aseptic technique. Aseptic technique was largely taught by lecturers in university with little input from infection prevention and control nurses.

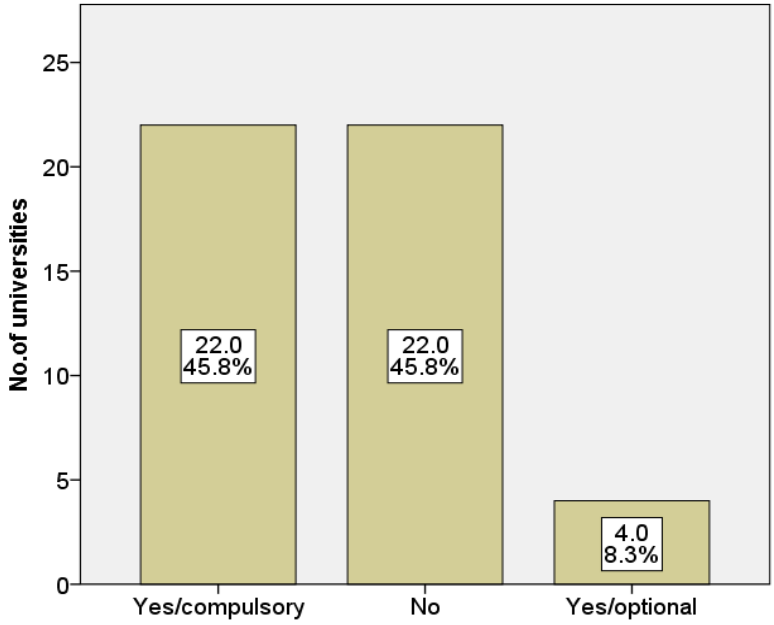
A blended learning approach to aseptic technique in university was apparent. There was high expectation for self-directed learning of aseptic technique (pre-reading and e-learning) prior to formal teaching sessions. All students were reported to have opportunity to practice aseptic technique in sessions in the majority 93.8% (n=45) of universities. Use of objective methods of feedback upon students' performance of aseptic technique was not commonplace. More teaching and practice of aseptic technique were the most common recommendations for change made by nurse educators.

6.4.4 Research Question 4 - How is aseptic technique assessed in pre-registration nursing programmes in the UK?

6.4.4.1 Assessment of aseptic technique knowledge in university

An equal number, 45.8% (n=22) of universities reported either having or not having a compulsory summative assessment of students' knowledge of aseptic technique (see Figure 23).

Figure 23 Percentage of universities with a summative assessment of knowledge (n=48)



Of universities offering a summative assessment of knowledge(n=26), 65.4% (n=17) assess knowledge of aseptic technique in the first year (see Table 50). Thirteen of these universities assessed knowledge in the first year only.

Table 50.Summative assessment of knowledge

	Summative assessment of knowledge
Year of programme	**n (%) of universities**
1	17 (65.4)
2	10 (38.5)
3	4 (15.4)
4	0
Any year	1 (3.8)
Responses based on n=26 universities for Years 1-3 and n=3 for Year 4	

Cohort size and number of student intakes might influence the type and method of assessment of aseptic technique in the university setting and therefore relationships were looked for. Some universities at the time of the survey reported the loss of OSCEs from their programmes due to resources. Programmes with larger numbers of students might be less likely to summatively assess nursing students' knowledge or performance in the university setting. A cross-tabulation showed no evidence of a relationship between the number of student intakes and summative assessment of knowledge (see Table 51).

Table 51.Number of student intakes and summative assessment of knowledge

	Summative assessment of knowledge		
Number of student intakes	Yes (compulsory/optional)	No	Total
One	12 46.2%	10 45.5%	22 45.8%
Two	14 53.8%	12 54.5%	26 54.2%
Total	26 100.0%	22 100.0%	48 100.0%

A cross-tabulation of cohort size and summative assessment of aseptic technique knowledge (see Table 52) showed greater use of a summative assessment of knowledge in larger cohort sizes. A Mantel Haenszel test for trend found a significant association between cohort size and summative assessment of students' knowledge of aseptic technique χ^2 (1) =4.228 (*p=0.040*).

Table 52.Cohort size and summative assessment of knowledge

	Summative assessment of knowledge		
Cohort Size	Yes (compulsory/optional)	No	Total
Small	2 7.4%	2 9.5%	4 8.3%
Medium	12 44.4%	16 76.2%	28 58.3%
Large	13 48.1%	3 14.3%	16 33.3%
Total	27 100.0%	21 100.0%	48 100.0%

The use of one summative knowledge assessment method was reported by 88% (n=23) of universities. An Objective Structured Clinical Examination (OSCE) or Objective Structured Clinical Assessment (OSCA) were the most popular methods reported by 38.5% (n=10) of universities (see Table 53).

Table 53.Type of summative assessment of knowledge

Type of assessment	Universities n=26
	n (%)
Written exam	6 (23.1)
MCQs	6 (23.1)
OSCE/OSCA	10 (38.5)
Other	7 (26.9)

Number of student intakes and different methods of summative assessment of knowledge were cross-tabulated and showed no evidence of any relationships (see Table 54).

Table 54.Number of student intakes and different summative assessment methods

		Methods of assessment		
		Written examination		
		Yes	No	Total
No. of intakes	One	3 50.0%	9 45.0%	12 46.2%
	Two	3 50.0%	11 55.0%	14 53.8%
Total		6 100%	20 100%	26 100%
		MCQs		
		Yes	No	Total
No. of intakes	One	2 33.3%	10 50.0%	12 46.2%
	Two	4 66.7%	10 50.0%	14 53.8%
Total		6 100%	20 100%	26 100%
		OSCE/OSCA		
		Yes	No	Total
No. of intakes	One	5 50.0%	7 43.8%	12 46.2%
	Two	5 50.0%	9 56.2%	14 53.8%
Total		10 100%	16 100%	26 100%
		Other		
		Yes	No	Total
No. of intakes	One	3 42.9%	9 47.4%	12 46.2%
	Two	4 57.1%	10 52.6%	14 53.8%
Total		7 100%	19 100%	26 100%

Cohort size was cross-tabulated with different methods of summative assessment (see Table 55) and suggested that use of Multiple Choice Questions (MCQs) tests

might be lower in medium to large cohorts. A Mantel Haenszel test for trend found a statistically significant association between cohort size and use of MCQs χ^2 (1) =3.867 (*p=0.049).*

Table 55.Cohort size and different methods of summative assessment

		Method of summative assessment of knowledge		
		Written examination		
		Yes	No	Total
Cohort size	Small	1 16.7%	1 5.0%	2 7.7%
	Medium	2 33.3%	10 50.0%	12 46.2%
	Large	3 50.0%	9 45.5%	12 46.2%
Total		6 100.0%	20 100.0%	26 100.0%
		MCQs		
		Yes	No	Total
Cohort size	Small	0 0.0%	2 10.0%	2 7.7%
	Medium	1 16.7%	11 55.5%	12 46.2%
	Large	5 83.3%	7 35.0%	12 46.2%
Total		6 100.0%	20 100.0%	26 100.0%
		OSCE/OSCA		
		Yes	No	Total
Cohort size	Small	1 10.0%	1 6.2%	2 7.7%
	Medium	6 60.0%	6 37.5%	12 46.2%
	Large	3 30.0%	9 56.2%	12 46.2%
Total		10 100.0%	16 100.0%	26 100.0%
		Other		
		Yes	No	Total
Cohort size	Small	0 0.0%	2 10.5%	2 7.7%
	Medium	4 57.1%	8 42.1%	12 46.2%
	Large	3 42.9%	9 47.4%	12 46.2%
Total		7 100.0%	19 100.0%	26 100.0%

6.4.4.2 Assessment of performance in aseptic technique in university

Students' performance of aseptic technique was reported to be assessed in university by just over half, 54.2% (n=26) of universities. Of these, 50% (n=13) reported summative assessment of students' performance of aseptic technique (see Table 56). A larger proportion, 65.4% (n=17) reported formative assessment. Peer assessment was the most common formative assessment used by 70.6% (n=12) of universities. An OSCE/OSCA was the most common summative assessment reported by 76.9% (n=10) of universities.

Table 56.Assessment of students' performance in aseptic technique

	Universities n (%)		**Universities** n (%)
Formative assessment	17(65.4)	**Summative assessment**	13 (50)
Method		**Method**	
Self-assessment	2 (11.8)	OSCE/OSCA	10 (76.9)
Peer assessment	12 (70.6)	Live practical assessment	2 (15.4)
Facilitator assessment	9 (52.9)	Assessment of video performance	0
Service /client assessment	0	Other assessment	1 (7.7)
Other assessment	1 (5.9)		

Table 57 shows that a higher number of universities reported assessment of students' performance of aseptic technique in university in the first year than in any other year of the programme. A higher percentage 88.2% (n=15) of universities reported the use of a formative assessment of students' performance in aseptic technique in the first year compared with a summative assessment in 61.5% (n=8) of universities. Seven universities reported summative assessment in the first year only.

Table 57.Formative or summative assessment of students' performance

Year of programme	**Formative assessment**	**Summative assessment**
	n (%) of universities	n (%) of universities
1	15 (88.2)	8 (61.5)
2	6 (35.3)	5 (38.5)
3	3 (17.6)	2 (15.4)
4	0	0
Any year		1 (7.7)
	Responses based on n=17 universities	*Responses based on n=13 universities*

A cross-tabulation (see Table 58) indicated no relationship between number of student intakes and assessment of aseptic technique performance.

Table 58.Number of student intakes and assessment of aseptic technique performance

	Is students' performance of aseptic technique assessed in university?		
Number of student intakes	Yes	No	Total
One	12 46.2%	10 45.5%	22 45.8%
Two	14 53.8%	12 54.5%	26 54.2%
Total	26 100%	22 100%	48 100%

A cross-tabulation showed no evidence of any relationship between cohort size and assessment of aseptic technique performance (see Table 59).

Table 59.Cohort size and assessment of aseptic technique performance

	Is students' performance of aseptic technique assessed in university?		
Cohort Size	Yes	No	Total
Small	2 7.7%	2 9.1%	4 8.3%
Medium	17 65.4%	11 50.0%	28 58.3%
Large	7 26.9%	9 40.9%	16 33.3%
Total	26 100.0%	22 100.0%	48 100.0%

Number of student intakes was cross-tabulated with formative assessment of aseptic technique performance (see Table 60) and appeared to be independent of each other.

Table 60.Number of student intakes and formative assessment of aseptic technique performance

	Formative assessment of aseptic technique performance in university		
Number of student intakes	Yes	No	Total
One	9 52.9%	3 33.3%	12 53.8%
Two	8 47.1%	6 66.7%	14 46.2%
Total	17 100%	9 100%	26 100%

Cohort size was cross-tabulated with formative assessment of aseptic technique performance in university (see Table 61). The cross-tabulation indicated greater use of a formative assessment of aseptic technique in smaller and medium size cohorts than in large cohorts. A Mantel Haenszel test for trend found a statistically significant association between cohort size and use of formative assessment of aseptic technique performance χ^2 (1) =5.649 (*p=0.024).*

Table 61.Cohort size and formative assessment of aseptic technique performance

	Formative assessment of aseptic technique performance in university		
Cohort Size	Yes	No	Total
Small	2 11.8%	0 0.0%	2 7.7%
Medium	13 76.5%	4 44.4%	17 65.4%
Large	2 11.8%	5 55.6%	7 26.9%
Total	17 100.0%	9 100.0%	26 100.0%

A cross-tabulation showed no support for a relationship between number of intakes and any type of formative assessment: self-assessment/reflection, peer assessment, facilitator assessment or other types of formative assessment (see Table 62).

Table 62.Number of student intakes and different types of formative assessment of aseptic technique performance

		Type of formative assessment in use		
		Self-assessment/reflection		
		Yes	No	Total
No. of intakes	One	1 50.0%	8 53.3%	9 52.9%
	Two	1 50.0%	7 46.7%	8 47.1%
Total		2 100%	15 100%	17 100%
		Peer		
		Yes	No	Total
No. of intakes	One	6 50%	3 60.0%	9 52.9%
	Two	6 50%	2 40.0%	8 47.1%
Total		12 100%	5 100%	17 100%
		Facilitator/faculty assessment		
		Yes	No	Total
No. of intakes	One	4 44.4%	5 62.5%	9 52.9%
	Two	5 55.6%	3 37.5%	8 47.1%
Total		9 100%	8 100%	17 100%
		Client/service user feedback		
		Yes	No	Total
No. of intakes	One	-	9 52.9%	9 52.9%
	Two	-	8 47.1%	8 47.1%
Total			17 100%	17 100%
		Other formative assessment		
		Yes	No	Total
No. of intakes	One	0 -	9 56.2%	9 52.9%
	Two	1 100%	7 43.8%	8 47.1%
Total		1 100%	16 100%	17 100%

A cross-tabulation (see Table 63) showed differences in the use of different formative assessment methods in programmes with medium size cohorts compared to those with small and large intakes. A Mantel Haenszel test for trend showed only

a statistically significant association between cohort size and the use of other types of formative assessment, not listed in the table below χ^2 (1) =4.250 (*p=0.039).*

Table 63.Cohort size and different methods of formative assessment of aseptic technique performance

		Methods of formative assessment		
		Self-assessment/reflection		
		Yes	No	Total
Cohort Size	Small	0 0.0%	2 13.3%	2 11.8%
	Medium	2 100.0%	11 73.3%	13 76.5%
	Large	0 0.0%	2 13.3%	2 11.8%
Total		2 100.0%	15 100.0%	17 100.0%
		Peer assessment		
		Yes	No	Total
Cohort Size	Small	1 8.3%	1 20.0%	2 11.8%
	Medium	11 91.7%	2 40.0%	13 76.5%
	Large	0 0.0%	2 40.0%	2 11.8%
Total		12 100.0%	5 100.0%	17 100.0%
		Facilitator/faculty assessment		
		Yes	No	Total
Cohort Size	Small	2 22.2%	0 0.0%	2 11.8%
	Medium	6 66.7%	7 87.5%	13 76.5%
	Large	1 11.1%	1 12.5%	2 11.8%
Total		9 100.0%	8 100.0%	17 100.0%

Table 63. Cohort size and different methods of formative assessment of aseptic technique performance (continued)

		Client/service user feedback		
		Yes	No	Total
Cohort Size	Small	0 0.0%	2 11.8%	2 11.8%
	Medium	0 0.0%	13 76.5%	13 76.5%
	Large	0 0.0%	2 11.8%	2 11.8%
Total		0 0.0%	17 100.0%	17 100.0%
		Other formative assessment		
		Yes	No	Total
Cohort Size	Small	0 0.0%	2 12.5%	2 11.8%
	Medium	0 0.0%	13 81.2%	13 76.5%
	Large	1 100.0%	1 6.2%	2 11.8%
Total		1 100.0%	16 100.0%	17 100.0%

A cross-tabulation showed no evidence of an association between number of student intakes and summative assessment of aseptic technique performance (see Table 64).

Table 64.Number of student intakes and summative assessment of aseptic technique performance

	Summative assessment of aseptic technique performance in university		
Number of student intakes	Yes	No	Total
One	6 46.2%	6 46.2%	12 46.2%
Two	7 53.8%	7 53.8%	14 53.8%
Total	13 100%	13 100%	26 100.0%

Cohort size and summative assessment of aseptic technique performance was cross-tabulated (see Table 65) and showed no evidence of an association.

Table 65.Cohort size and summative assessment of aseptic technique performance

	Summative assessment of aseptic technique performance in university		
Cohort size	Yes	No	Total
Small	1 7.7%	1 7.7%	2 7.7%
Medium	7 53.8%	10 76.9%	17 65.4%
Large	5 38.5%	2 15.4%	7 27.0%
Total	13 100.0%	13 100.0%	26 100.0%

There was no proof of a relationship between number of student intakes and reported use of different summative assessment methods of performance when cross tabulated (see Table 66).

Table 66.Number of student intakes and different methods of summative assessment of aseptic technique performance

	Method of summative assessment of performance			
		OSCE/OSCA		
		Yes	No	Total
No. of intakes	One	4 40.0%	2 66.7%	6 46.2%
	Two	6 60.0%	1 33.3%	7 53.8%
Total		10 100.0%	3 100.0%	13 100.0%
		Live practical demonstration/ assessment		
		Yes	No	Total
No. of intakes	One	1 50.0%	5 45.5%	6 46.2%
	Two	1 50.0%	6 55.5%	7 53.8%
Total		2 100.0%	11 100.0%	13 100.0%
		Review & assessment of video performance		
		Yes	No	Total
No. of intakes	One	-	6 46.2%	6 46.2%
	Two	-	7 53.8%	7 53.8%
Total		-	13 100%	13 100%

Table 66. Number of student intakes and different methods of summative assessment of aseptic technique performance (continued)

		Other assessment methods		
		Yes	No	Total
No. of intakes	One	1 100.0%	5 41.7%	6 46.2%
	Two	0 0.0%	7 58.3%	7 53.8%
Total		1 100%	12 100.0%	13 100.0%

A cross-tabulation suggested no relationship between cohort size and different methods of summative assessment of aseptic technique performance (see Table 67).

Table 67.Cohort size and different methods of summative assessment of aseptic technique performance

	Method of summative assessment of performance			
		OSCE/OSCA		
		Yes	No	Total
Cohort Size	Small	1 10.0%	0 0.0%	1 7.7%
	Medium	5 50.0%	2 66.7%	7 53.8%
	Large	4 40.0%	1 33.3%	5 38.5%
Total		10 100.0%	3 100.0%	13 100.0%
		Live practical assessment		
		Yes	No	Total
Cohort Size	Small	0 0.0%	1 9.1%	1 7.7%
	Medium	1 50.0%	6 54.5%	7 53.8%
	Large	1 50.0%	4 36.4%	5 38.5%
Total		2 100.0%	11 100.0%	13 100.0%

Table 67. Cohort size and different methods of summative assessment of aseptic technique performance (continued)

		Recording &review of performance		
		Yes	No	Total
Cohort Size	Small	0 0.0%	1 7.7%	1 7.7%
	Medium	0 0.0%	7 53.8%	7 53.8%
	Large	0 0.0%	5 38.5%	5 38.5%
Total		0 0.0%	13 100.0%	13 100.0%
		Other assessment methods		
		Yes	No	Total
Cohort Size	Small	0 0.0%	1 8.3%	1 7.7%
	Medium	1 100.0%	6 50.0%	7 53.8%
	Large	0 0.0%	5 41.7%	5 38.5%
Total		1 100.0%	12 100.0%	13 100.0%

6.4.4.3 Assessment of competency in aseptic technique in clinical practice

The majority, 95.9% (n=47), of programmes had a summative assessment of students' competency in aseptic technique in clinical practice. Assessment of competency in aseptic technique was stated to be optional by one respondent. Two universities reported not assessing students' competency in clinical practice. A high number of universities reported assessing competency in years two: 95.7% (n=47) and three: 87.2% (n=41) (see Table 68). Two universities reported not stipulating the year in which aseptic technique competency was summatively assessed. One of these universities encouraged the assessment of competency from the second year onwards. The other university stated that competency in aseptic technique had to be achieved by the end of the programme through an individual development plan rather than the ongoing achievement record.

Table 68.Assessment of competency in clinical practice

Year of programme	**Assessment of competency in clinical practice**
	n (%) of universities
1	17 (36.2)
2	45 (95.7)
3	41(87.2)
4	1(33.3)
Any year	2 (4.3)
Responses are based on n=47 universities for Years 1- 3 year and n=3 universities for Year 4	

Table 69 below shows the pattern of competency assessment in aseptic technique in clinical practice across three and four year programmes. Over half, 53% (n= 24), of universities assessed aseptic technique in both years two and three of the programme in accordance with the NMC Essential Skills cluster 25 progression points (NMC 2010) (see Chapter 3). Over a third, 35.7% (n=16), of universities reported assessing aseptic technique competency in every year of the programme.

Table 69.Patterns in competency assessment in clinical practice across programmes

	Three Year Programme				Four Year Programme				
Number of years	**Yr 1**	**Yr 2**	**Yr 3**	n (%) of Universities	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	n (%) of Universities
1		√		4 (9.5)					
2		√	√	23 (54.8)		√	√		1 (33.3)
3	√	√	√	15 (35.7)	√	√	√		1 (33.3)
4					√	√	√	√	1 (33.3)
				42 (100%)					3 (100%)
n=2 universities did not assess competency & n=2 universities assessed competency in any year of the programme)									

Almost half of all universities, 46.8% (n=22), summatively assessed competency directly in accordance with the NMC Essential Skill Cluster 25 competency statements for the second progression point (2nd year) and upon entry to the register (3rd/4th year) (NMC 2010). Other universities reported using different competency statements or assessing at different progression points.

The frequency of assessment of students' competency in aseptic technique in clinical practice varied across programmes (see Table 70). The majority of universities, 78.7% (n=37), reported that it was a minimum requirement for students'

competency to be assessed and signed off at least once in each academic year. In 14.9% (n=7) of universities a greater frequency of assessment of competency in aseptic technique was reported more than once per year.

Table 70.Frequency of competency assessment in clinical practice

Minimum requirement for signing competency	**n (%) of universities**
Once in the placement	4 (8.5)
2-3 times per placement	1 (2.1)
Once per year	37 (78.7)
2-3 times per year	2 (4.3)
At least once in the programme	2 (4.3)
None (optional)	1(21.7)
	Total 47 (100%)
Responses based on n=47 universities that assess competency in practice	

Direct observation of students' performance of aseptic technique in clinical practice by mentors or registered nurses was a requirement for competency assessment in clinical practice in all 100% (n=47) universities (see Table 71). Discussion and questioning by a mentor/registered nurse to establish underlying knowledge and understanding of aseptic technique was a criterion in 83.6% (n=39) of universities. A small percentage, 6.4% (n=3), of universities reported use of a summative ANTT or criteria based competency assessment to assess students' competency in aseptic technique in clinical practice.

Table 71.Criteria for assessment of competency in clinical practice

Criteria for assessment in practice	**n (%) of universities**
Direct observation by mentor/registered nurse	47 (100)
Review of written evidence by mentor	21 (47)
Discussion/questioning by mentor	39 (83.6)
ANTT or criteria based competency assessment	3 (6.4)
Feedback from others	4 (8.5)
Through Simulation	3 (6.4)
Responses based on n=47 universities	

When respondents were asked what three changes they would make to the way aseptic technique is taught or assessed, the inclusion of a university based summative assessment for aseptic technique was the most common response made by 32.6 % (n=15) of universities (see Table 72).

Table 72.Proposed changes to the way aseptic technique is assessed

Suggestions for change	No (%) of universities
Assessment of aseptic technique	
University summative assessment (OSCE or knowledge)	15 (32.6)
Formal performance assessment criteria in practice	8 (17.4)
Improve mentor knowledge/robustness of mentor assessment	4 (8.7)
Annual assessment of students' performance	3 (6.5)
Others	9 (19.6)

6.4.4.4 Summary

Limited opportunity for summative assessment of students' knowledge and competency in aseptic technique in university was reported. Competency assessment in aseptic technique in clinical practice was not compulsory in all universities. Students might not undergo regular competency assessment in university or clinical placements. No universal assessment of aseptic technique existed. An ANTT or performance criteria based assessment in clinical practice was rare. A university based summative assessment was the most common recommendation made by nurse educators for improving the way aseptic technique is assessed.

Chapter 7- Phase 2 case-study findings

7.0 Introduction

This chapter presents the phase two case-study findings. A summary of the case-study data will be provided first, followed by a description of the two Case-Study Sites. Mandatory HCAI surveillance data for each NHS Trust will provide contextual information about how effectively HCAI was being managed, in order to help understand each case. The case-study findings will then be presented under research questions four and five (see chapter 5), drawing on interview data, observation of teaching and documentary evidence.

7.1 Summary of case-study data

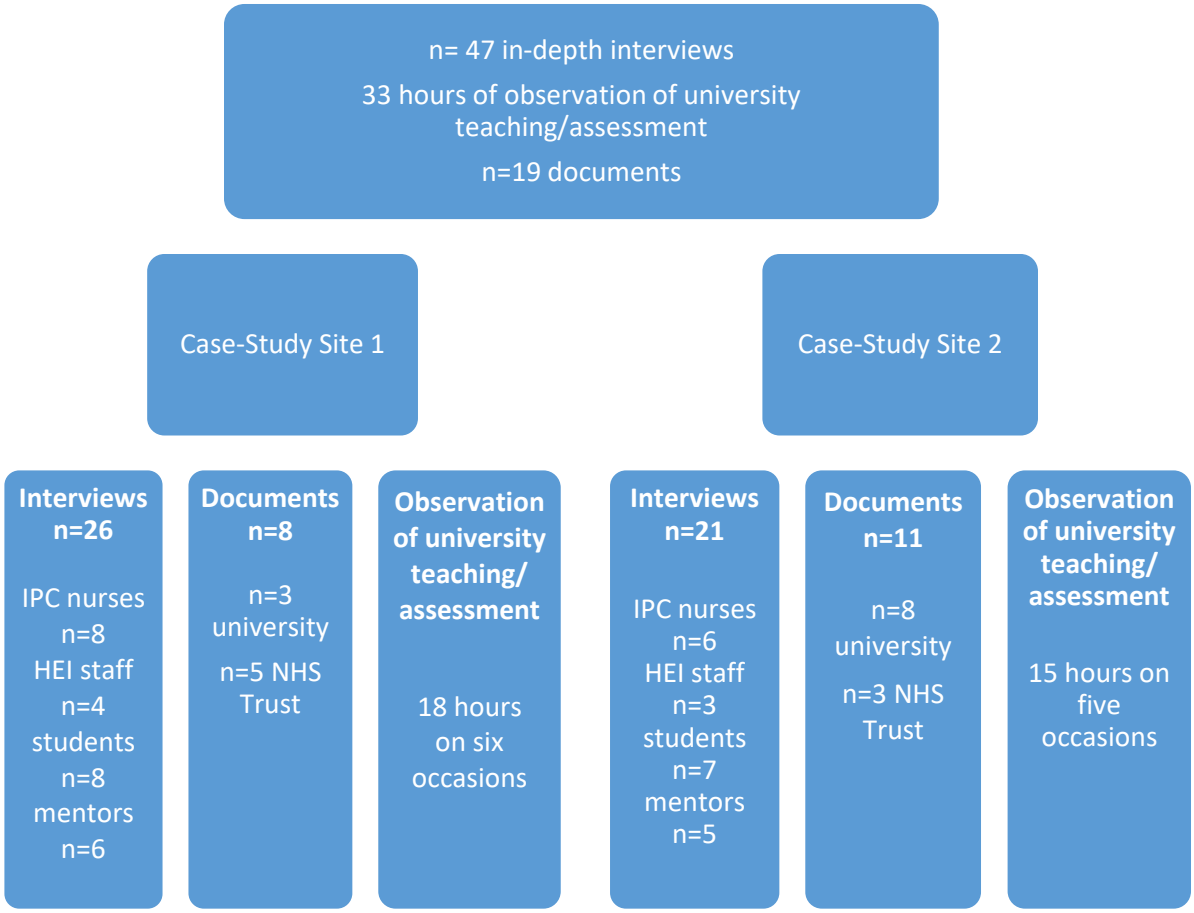
Data collected at each Case-Study Site is shown in Figure 24. In-depth telephone interviews (n=47) were conducted across two Case-Study Sites. The duration of interviews ranged from 19 - 62 minutes, with a mean average of 40.4 minutes. Thirty-three hours of observation of university teaching was undertaken in total and nineteen documents retrieved for analysis. Further details of observation and documentary data retrieved from each Case-Study Site can be found in Appendix 12. The Case-Study Sites are labelled 1 or 2 and each NHS Trust with a letter (A-G) to preserve the anonymity of the site and participants. Quotations are labelled by Case-Study Site: CSS1 or 2 and then by type of participant: HEI, IPC, M, S for higher education institute staff member, infection prevention nurse, mentor and student respectively and a unique number e.g. CSS2.M1.

7.2 Description of Case-Study Sites

7.2.1 Universities and programmes

The two Case-Study Sites were selected to provide two contrasting cases. They were located in different countries within the UK. Based on eight criteria of good educational practice developed from the phase one survey (see Chapter 5), Case-Study Site 1, met the least criteria and Case-Study Site 2, the most criteria. The university in Case-Study Site 2 reported the use of more innovative approaches in the teaching of aseptic technique in the phase one survey, than in Case-Study Site 1. Nursing students' performance of aseptic technique in university was reported to be assessed in university in Case-Study Site 2 but not in Case-Study Site 1.

Figure 24 Summary of data from each Case-Study Site



7.2.2 Case-Study Site 1

The university had four campuses in three different geographical locations. In 2014/15 total student numbers for the university were approximately 27,000. The undergraduate, pre-registration adult nursing programme was delivered on one campus on the outskirts of a town. There were two intakes of students per year with an approximate intake of 201-300 adult nursing students per year.

There were nine clinical placements within the programme. There were three terms in each academic year. In term one, students spent 10-weeks in university, followed by 8-weeks in a clinical placement. In terms two to eight, students spent 6-weeks in university and 6-weeks in a clinical placement. In term nine, 12-weeks were spent in clinical placement. The university utilized three NHS Trusts (A-C) for clinical placements.

7.2.3 Case-Study Site 2

The university had one city centre campus with an intake of approximately 27,000 students in 2014/15. The undergraduate, pre-registration adult nursing programme was delivered in one building in the city centre campus. The programme had two intakes of students per year with an approximate intake of 101-200 adult nursing students per year. Students completed six clinical placements within the programme. There were two placements per year, each of 10-week duration in years one and two and two placements of 8 weeks and 12 weeks duration in year three. The university utilized four NHS Trusts (D-G) where students undertook clinical placements.

7.2.4 NHS Trusts

The profile of each NHS Trust at Case-Study Site 1 and 2 is summarised in Table 73.

Table 73.Profile of each NHS trust in Case-Study Site 1 and 2

NHS Trust	Size of population	Facilities/Services	Infection Prevention & Control (IPC) team
Case-Study Site 1			
A	289,400	2 district hospitals 5 community hospitals	(n=9) 1 Lead IPC nurse 8 IPC nurses
B	639,000	2 large district hospitals 2 general hospitals 9 community/mental health day care centres	(n=8) 1 consultant IPC nurse 1 Lead IPC nurse 6 IPC nurses
C	500,000	4 acute hospitals/ community hospitals/primary care centres	(n=11) 1 Head of IPC nursing 1 Lead IPC nurse 9 IPC nurses
Case-Study Site 2			
D	Over 500,000	4 hospitals & community services	(n=4) 1 IPC Matron 3 IPC nurses
E	Over 1 million	2 hospitals-services/regional centres for specialities	(n=7) 1 IPC Matron 6 IPC nurses
F	300,000	1 hospital & range of community based services	(n=4)1 Lead IPC nurse 3 IPC nurses
G	1 million	Mental health/learning disability/community services	(n=2) 2 IPC nurses

Infection prevention teams varied in size but were generally larger in NHS Trusts in Case-Study Site 1, covering a greater number of acute and community services than in Case-Study Site 2. In the country where Case-Study Site 1 was situated, ANTT was being rolled out nationally and a national policy was under development. In Case-Study Site 2, NHS Trusts were either considering or

planning to introduce ANTT. One NHS Trust D declined to participate in the study. Only one NHS Trust G at Case-Study Site 2 had a specific asepsis policy.

7.2.4.1 Infection rates

The infection rates at the time of the study suggest that the management of HCAI was more effective in NHS trusts in Case-Study site 2 than 1. NHS Trusts in Case-Study 1 were not achieving the national targets for *Clostridium difficile* or meticillin-resistant *Staphylococcus aureus* (MRSA). Meticillin-sensitive *Staphylococcus aureus* (MSSA) rates also increased. In comparison, in Case-Study Site 2 three NHS Trusts met their individual targets for *Clostridium difficile.* Half of all NHS Trusts met the national zero tolerance target for MRSA and saw a reduction in MSSA rates. Infection rates are reported separately below for each Case-Study Site due to recording and reporting difference between countries making comparisons difficult.

In Case-Study Site 1, the national target rate for *Clostridium difficile* and MRSA bacteraemias in 2014/15 was 50% lower than baseline rate in 2012/13 of 63 and 5.2 per 100,000 population respectively. The target to reduce the rate of *Clostridium difficile* to 31 per 100,000 population or less was not achieved by any of the NHS Trusts (see Table 74).

Table 74.Clostridium difficile rates per 100,000 population for each NHS Trust and percentage change between 2012/13 and 2014/15

NHS Trust	2012/13 baseline *Clostridium difficile* per 100,000 population	Apr 14 -Sep 15 target period *Clostridium difficile* per 100,000 population	% change between baseline & target period
A	33.28	31.28	-6%
B	70.07	37.30	-47%
C	50.63	52.60	+4%

For MRSA, the national target in 2014/15 was a reduction of 2.6 per 100,000 population or lower which was achieved by NHS Trust A only (see Table 75) which made greatest reduction from baseline. Nationally, the rate was 4.7 per 100,000 population in 2014/15, an 11% reduction in the rate compared to the 2012/13 baseline.

Table 75.MRSA rates per 100,000 population for each NHS Trust and percentage change between 2012/13 and 2014/15

NHS Trust	2012/13 baseline MRSA per 100,000 population	Apr 14 -Sep 15 target period MRSA per 100,000 population	% change between baseline & target period
A	6.45	3.83	-41%
B	3.98	3.90	-2%
C	5.20	3.82	-26%

The national rate of Meticillin-sensitive *Staphylococcus aureus* (MSSA) bacteraemia per 100,000 population increased by 1% compared to 2012/13 from 24.36 to 24.62.

In Case-Study Site 2, the infection rates for *Clostridium difficile* are presented against the individual targets set for each NHS Trust (see Table 76). Three NHS Trusts met their targets and one NHS Trust failed to meet its target.

Table 76.Clostridium difficile cases for 2015/16

NHS Trust	*Clostridium Difficile* cases 2015/16	Target no. of cases	% change from 2014/15
D	21	6	+110%
E	38	42	-7%
F	6	13	-45%
G	2	2	0%

The infection rates for MRSA are presented against the national zero tolerance target for MRSA (see Table 77). Two NHS Trusts met this target.

Table 77.MRSA cases for 2014/15 and 2015/16

NHS Trust	MRSA cases 2014/15	MRSA cases 2015/16	Target no.of cases
D	0	2	0
E	9	0	0
F	0	3	0
G	0	0	0

The number of MSSA cases for 2015/16 and percentage change from 2014/15 are reported in Table 78. One NHS Trust showed a reduction in MSSA cases whereas two NHS Trusts saw an increase in the number of MSSA cases.

Table 78.MSSA cases for 2014/15 and 2015/16 and percentage change from 2014/15

NHS Trust	MSSA cases 2014/15	MSSA cases 2015/16	% change from 2014/15
D	12	4	-67%
E	15	22	+47%
F	5	8	+60%
G	0	0	0%

7.2.5 Simulation/Teaching facilities

Case-Study Site 1 had a designated clinical simulation centre where aseptic technique teaching took place. A paediatric unit, emergency department, clinical skills room and two mock ward areas were used. In Case-Study Site 2, aseptic technique teaching occurred in multiple purpose classrooms for clinical skills. A simulation centre was due for completion by 2017. Low fidelity patient simulators and students as patients were used in aseptic technique teaching at Case-Study Sites 1 and 2. In Case-Study Site 1, high fidelity patient simulators were also used. In Case-Study Site 1, cameras were installed in all areas but were not used to record students' performance of aseptic technique. In Case-Study Site 2, there were no cameras. There was technical and support staff in Case-Study Site 1, but not in Case-Study Site 2.

7.2.6 Aseptic technique teaching

There were approximately 14 hours of teaching aseptic technique in Case-Study Site 1 and 21 hours of compulsory teaching aseptic technique in Case-Study Site 2 (see Appendix 12). In Case-Study Site 1, there were a total of ten observation periods of teaching by seven different facilitators on six different days. Some sessions were observed on multiple occasions. The researcher was not given the opportunity to observe all sessions where aseptic technique was taught or view any of the in-house produced videos despite requesting access. In Case-Study Site 1, aseptic technique was observed to be taught by two full-time clinical skills trainers with input from a wider team of practice facilitators and lecturers. ANTT was being incorporated into teaching in Case-Study Site 1 but not at Case-Study Site 2. The third year nursing students interviewed in Case-Study Site 1 were the first cohort of students to complete the ANTT e-learning resource. Learning was also supported by online access to Clinical skills net and The Royal Marsden Clinical Procedures (Dougherty and Lister 2015) throughout the programme in Case-Study Site 1.

In Case-Study Site 2, there was a total of five observation periods of three different facilitators on four different days. The researcher was not given access to observe all sessions identified in the phase one survey. Most sessions were observed on one occasion. The in-house produced video for aseptic technique in wound care was viewed by the researcher. In Case-Study Site 2, a designated skills team of full-time lecturers and clinical skills instructors who currently practise in NHS Trusts were observed teaching aseptic technique.

7.2.7 Assessment of aseptic technique

In Case-Study Sites 1 and 2, there was no formative or summative assessment of students' performance of aseptic technique in university. Observation of the OSCE in Case-Study Site 2 confirmed there was no assessment of students' performance of aseptic technique in suture removal as reported in the phase one survey. In Case-Study Site 1, each student had a record of generic skills development. A clinical skills trainer or lecturer would sign the record when students were taught and observed undertaking a non-touch aseptic dressing technique in university. Students were also required to record when they had observed and practised a non-touch aseptic dressing technique under direct supervision of the mentor in clinical practice in each year of the programme. Students had to achieve competency in aseptic technique in wound care by the end of the second year, requiring a mentor signature in their practice assessment document at least once during the year. In Case-Study Site 2, the Essential Skills Record for years two and three, required students to have a competency for aseptic technique in wound care to be signed off by a registered healthcare professional in each clinical placement. The next section will present the case-study findings from interview data, observation of teaching and documentary evidence under research questions four and five.

7.3. Research Question 4 - How do nursing students', mentors', nurse educators' and infection prevention nurses' knowledge and understanding of aseptic technique compare in two contrasting cases (universities and NHS Trusts)?

Analysis revealed a single, overarching theme called **'**Different knowledge, understanding and practices of aseptic technique' and three associated sub-themes to address this question. The sub-themes were:

- Confusion

- Confidence in competency levels
- Lack of standardised practise

The above sub-themes applied to all types of participants: nursing students, mentors, nurse educators and infection prevention nurses. The overarching theme will be described first, and then each sub-theme will be presented in turn.

7.3.1 Theme 1- Different knowledge, understanding and practices of aseptic technique

This theme illustrates the differences in knowledge, understanding and practices of aseptic technique in all types of participants (nursing students, mentors, nurse educators and infection prevention nurses) within the same Case-Study Sites and across both Case-Study Sites. Knowledge and understanding have previously been defined (see section 5.2). The three underlying sub-themes: confusion, confidence in competency levels and lack of standardised practice are described below.

7.3.1.1 Sub-theme 1 – Confusion

This sub-theme illustrates the confusion and lack of clarity about the meaning of aseptic technique among all types of participants: nursing students, mentors, nurse educators and infection prevention nurses within and across both Case-Study Sites. Confusion and lack of understanding of the principles of aseptic technique was also shown. Confusion was apparent in participants' responses during interviews, documentary evidence and observation of teaching in university.

Confusion and lack of clarity about the meaning of aseptic technique was apparent in qualified nurses and students from both Case-Study Sites. Aseptic technique was variously described, as a process, procedure or technique. A lack of clarity about whether the aim of an aseptic technique was to minimize or prevent the transmission of micro-organisms was apparent. The following are typical quotes taken from interviews:

> "...Aseptic technique, it's just a procedure that will minimise the risk of causing infection to invasive devices ... it's a way of minimising the risk of infecting and cross contamination." **(CSS1.M3)**

> "It's a process of dealing with ...any patient's wound, it's a technique that allows a clean technique where you have a sterile area which prevents any kind of bacteria getting into any of the wounds..." **(CSS2.S11)**

Confusion was shown in relation to the meaning of the terms 'cleanliness', 'asepsis' and 'sterility'. These terms were used interchangeably within the same response by participants from both Case-Study Sites, when explaining their understanding of 'aseptic technique'. The following quotes were taken from interviews:

> "So aseptic is to maintain sort of sterility ...of a procedure"
>
> **(CSS1.IPC8)**

> "I understand it (aseptic technique), when you're going to do something, yourself, the area, the patient, has to be as clean, as sterile as possible ... you've got all the tools to make it (aseptic technique) as sterile, as clean as possible..." **(CSS2.M8)**

This was corroborated by observation data. The following observations were made from teaching sessions for aseptic technique in wound care:

> The facilitator referred to the top of the trolley being 'sterile' and not to be touched and then 'clean' later in the session **(CSS1.Observation4-13/1/16)**

> When facilitators demonstrated how to clean the trolley in preparation for undertaking a wound dressing, reference was made to the top of the trolley being sterile **(CSS2. Observation- 8/1/16)**

Despite the above conflation of terms, one infection prevention nurse from Case-Study Site 2 showed some awareness of the differences in meaning of these terms. The following quote was taken from interviews:

> "Asepsis to me is not clean, and it's not sterile, it's in the middle, so it's realistic and achievable" **(CSS2.IPC13)**

Confusion around different terms associated with aseptic technique (e.g. asepsis, clean technique and ANTT) was apparent for participants from both Case-Study Sites irrespective of their post or whether they were qualified nurses or students. Typical interview quotes are reproduced from infection prevention nurses in each of the Case-Study Sites:

> "...Asepsis is quite confusing for us as infection control nurses, all different definitions of it now ... clean technique...aseptic technique, asepsis ..." **(CSS2.IPC14)**

> "They (infection prevention nurses) felt that the (ANTT) language was a little bit difficult ... we're talking about micro aseptic fields.... whereas back in traditional training you just said an aseptic field.... I like the ANTT approach but ...a couple of my colleagues (infection prevention nurses) have said ...that terminology is ...a bit confusing" **(CSS1.IPC12)**

Across both Case-Study Sites, different terms (i.e. 'aseptic technique', 'clean technique', 'no-touch technique', 'aseptic non-touch technique' or 'ANTT' and 'sterile technique') were used interchangeably by participants, for example, when referring to aseptic technique in different types of clinical procedures. The following quotes were taken from interviews with a nurse educator and mentor:

> "...They (students) would undertake an aseptic technique when ...inserting a urinary catheter in the second year (of the programme). In the first year (of the programme) ...we'd introduce... a sterile non-touch technique when they're preparing a subcutaneous or intra muscular injection..." **(CSS1.HEI 7)**

> "Aseptic technique...has to be a sterile technique... is used in certain kind of procedures for certain wounds..." **(CSS2.M10)**

This was corroborated by observation data. The following was taken from an observation of a teaching session:

> The facilitator talked about the use of an aseptic technique and a clean technique for the dressing of a laceration in the community setting. **(CSS2.Observation1-1/12/16)**

This was also supported by documentary evidence. In Case-Study Site 1 nine different terms related to aseptic technique were used in documents. In Case-Study Site 2 documents, thirteen different aseptic technique terms were identified. Documents reviewed included; NHS Trust policy documents for asepsis, intravenous cannulation and urinary catheterisation; powerpoint presentations used for teaching students, and students' clinical practice assessment documents (see Appendix 12). The following extract was taken from an asepsis policy document in Case-Study Site 2.

> Clean technique-This method is a modified aseptic technique which still aims to minimise the risk of transmission of pathogens in a clinical procedure but where the risk of transmission is lower. The clean technique must include the use of ANTT... **(CSS2.G Asepsis policy)**

Confusion and a lack of understanding of the principles of aseptic technique were evident in participants from both Case-Study Sites. When asked to identify the principles of aseptic technique they often sought clarification and/or

described the steps of the procedure. The following quotes taken from interviews illustrate typical responses:

> "What do you mean by that (question)?... washing their hands first off, ensuring they're wearing sterile gloves, making sure the area has been cleaned" **(CSS1.IPC6)**

> "... So you would wash your hands, get a sterile area, clean it, get it ready, wash your hands, and then you would do a procedure ... dressing a wound..." **(CSS2.M7)**

This was reinforced by observation data:

> The facilitator told students that one principle was not to touch the top surface of the trolley. Students were taught to use a two finger technique to manoeuvre the clean trolley to a patient's bedside prior to undertaking a wound care dressing. **(CSS1.Observation 2-6/1/16 &Observation 4-13/1/16)**

> The facilitator kept referring to the principles of aseptic technique but was describing and demonstrating the steps of aseptic technique in wound care **(CSS2.Observation 2-8/1/16)**

Confusion about how to apply a non-touch principle, to avoid contamination of a susceptible site on the patient, was apparent in nurse educators, mentors and students in both Case-Study Sites. The following quotes were taken from interviews:

> "...There's a touch and a non-touch technique isn't there?...if I was doing a catheter or a wound ...that would be ...a touch technique but if I was doing a Hickman line and I had to draw up, ...Hepsal ... I wouldn't touch the ampoule bottle..." **(CSS1.M3)**

> "...Non-touch, ... I would ...say minimal touch because sometimes you do have to touch but as long...I'm not touching with my gloves I'm touching with gauze ...is that classed as ...non-touch?..." **(CSS2.S9)**

By contrast, the following was taken from an interview with a student:

> "When ... opening the packaging ...we don't touch the dressing ... unless you've got your sterile gloves on so it's a no touch technique ...you only touch the outside and the dressing ...would only touch your sterile area..." **(CSS2.S11)**

Confusion was shown about how the principles of aseptic technique could be applied in different settings, for example in the domiciliary setting. An aseptic technique was perceived to be difficult to achieve in a patient's home by mentors, students and nurse educators in Case-Study Site 2 (met most criteria

for good educational practice). The following are typical quotes taken from interviews:

> "...In the community it's very difficult to practise aseptic technique because you...go into some environments that ...aren't very clean and it's almost impossible then for it to be aseptic..." **(CSS2.M10)**

> "...They (students) haven't got steel trolleys.... in the community, you have to find as best as possible surface that you can that is clean...I think it's difficult... ... there could be some invention where you have got a better surface to perform it on... a collapsible trolley..." **(CSS2.HEI2)**

This was reinforced by observation data. In Case-Study Site 2, nurse educators were observed informing students that an aseptic technique could not be performed in the domiciliary setting. They were also seen to provide students with a trolley to practice wound care in a simulated domiciliary community scenario. The following were taken from observations:

> Students were provided with trolleys when students were practising the performance of an aseptic technique during a community wound care scenario **(CSS2.Observation1-1/12/16)**

> Students were told by one facilitator that 'an aseptic technique in the community was not possible' when practising female urinary catheterisation upon a manikin at a skill station (**CSS2.Observation 2 & 3-11/3/16)**

In contrast, nurse educators at Case-Study Site 1 were observed informing students that they would not have a trolley to perform wound care in the community. They used the opportunity for students to problem solve how they might overcome this and adapt their aseptic technique accordingly. The following is an example of an observation made:

> Discussion with students about performing an aseptic technique in wound care in the community and having to adapt to the circumstances for example in the home **(CSS1.13/1/16 Facilitator 6)**

7.3.1.2 Sub-theme 2 – Confidence in competency levels

This sub-theme addresses qualified nurses', nurse educators',' mentors' and students' self-reported practice and perceptions of confidence in their competency levels and assessment. It also encompasses the practice of aseptic technique by nurse educators and students witnessed during the observation of teaching in the university setting.

Students in Case-Study Site 2 (met most criteria for good educational practice), reported greater confidence in their competency in aseptic technique than students in Case-Study Site 1 (met least criteria for good educational practice). The following quotes were taken from interviews with students:

> "I've got medium knowledge and competence ...I'm in my third year now so I should feel that I am fully competent to do it" **(CSS1.S7)**

> "...I think my skill in doing it is better than the knowledge I have on it ... I do feel confident at doing it.... on a scale of one to ten, about an eight..." **(CSS2.S15)**

Students and nurse educators from both Case-Study Sites identified similar difficulties in students developing their competency in aseptic technique, for example in donning gloves and maintaining the sterile field. One nurse educator from Case-Study Site 1 described a mismatch between students' perceptions of their level of competency and actual competency levels in the simulated environment. This is illustrated by the typical quotes below, taken from interviews:

> "...When we ...do it (aseptic technique) with the students they realise that they're not as competent as they think they are... very often, ... they contaminate the gloves, the sterile field... they might put their dirty hand and pick something up from the sterile field..." **(CSS1.HEI7)**

> "...As a student it takes you a little while to get used to putting on those gloves without touching the outside of them..." **(CSS2.S14)**

This was also supported by observation data. In thirteen out of fourteen observations of university teaching at both Case-Study Sites, students were seen to breach aseptic technique by unconsciously contaminating their gloves or sterile field (see Appendix 12). The following observations were made:

> Student had difficulty in the placement of their fingers in the gloves and contaminated the gloves by touching the outside of the sterile glove with the other ungloved hand. The sterile field was also contaminated through touch when opening the dressing pack and by the waste disposal bag when practising an aseptic technique in wound care. **(CSS1.Observation 6-1/2/16)**

> Students were seen to contaminate their gloves and the sterile field when placing the outside packaging of sterile gloves half on and off the sterile field during wound care **(CSS2.Observation 1-1/12/16)**

Students in both Case-Study Sites appeared dissatisfied with the way in which their clinical competency in aseptic technique was assessed. The following quotes were taken from interviews:

> "In our competencies, we haven't got anything that actually says ...aseptic technique achieved... or is capable of an aseptic technique." **(CSS1.S1)**

> "...Our essential skills aren't that specific, they're not like can a student catheterise, there's no tick sheet or for wound care ...an assessment ...a tick thing like can a student perform aseptic technique that would be good..." **(CSS2.S9)**

By contrast, one student in Case-Study Site 2, was positive about the assessment of their clinical competency. This is shown in the following interview quote:

> "...We got essential skills that we need to have signed off ... aseptic technique and that's got to be signed ...every year for every placement..." **(CSS2.S15)**

Mentors in both Case-Study Sites, were generally more positive about students' competency in aseptic technique than nurse educators and students. The following quotes were taken from interviews with mentors:

> "Some students are ...better than others ...they do tend to have the knowledge and skills to perform an aseptic technique" **(CSS1.M2)**

> "The ones (students) I've had; they've seemed competent..." **(CSS2.M7)**

Mentors within both Case-Study Sites were also highly confident about qualified nurses' aseptic technique practices within their own clinical area. This is demonstrated by the following quotes taken from interviews:

> "The ward I'm on now we are hot on infection control...the girls here are hot on their aseptic technique; it's done as it should be done." **(CSS1.M1)**

> "...Staff on here are pretty hot ... so when they go with their mentors to do an aseptic technique from what I've seen, it is done properly." (**CSS2.M8)**

A lack of opportunity for ongoing assessment of qualified nurses' competency in aseptic technique was apparent in both Case-Study Sites. The following quotes are taken from interviews with infection prevention nurses:

> "I don't think we're (qualified nurses) ever assessed to see if we're competent at doing an aseptic technique." **(CSS1.IPC11)**

> "When I ...did my preceptorship.... they had a competency package...ANTT was one of them and we were assessed doing...wound dressings ...cannulation..." (**CSS2.IPC4)**

Nurse educators and infection prevention nurses in Case-Study Site 1 raised concern about the rigour of mentor assessment of students' competency in aseptic technique in clinical practice. The following are typical quotes taken from interviews:

> ".... We used to have nurse educators ...come on the ward... spot testing...We can no longer assess them (students) out there, the mentors are busy and stressed... a clinical skills trainer visiting ... would assess the students more accurately..." **(CSS1.HEI3)**

> "...Student nurses' competencies ...I don't think they (students) should be signed off by the mentors on the ward because I think there's a lot of differentiation between what one person (mentors) will say oh yes that student is competent..." **(CSS1.IPC8)**

7.3.1.3 Sub-theme 3 - Lack of standardised practice

This sub-theme illustrates the perceived lack of standardisation in the teaching and practice of aseptic technique by infection prevention nurses, nurse educators and mentors. Dissonance between what is taught about aseptic technique within the classroom, in university and taught or seen to be practised by qualified nurses in clinical placements was reported by students.

The need to standardise the teaching of aseptic technique was perceived by qualified nurses irrespective of their post, from both Case-Study Sites. The following are typical quotes taken from interviews:

> "There should be a standard procedure, a universal procedure; everybody should be taught exactly the same way of how to undertake an aseptic technique so that everybody is doing exactly the same thing" **(CSS1.HEI7)**

> "... If you have one standard and everybody is taught the same, then you're more likely to get compliance if everybody is singing from the same hymn sheet..." **(CSS2.IPC3)**

Students from both Case-Study Sites perceived there to be variation in the practice of aseptic technique by qualified nurses within and across clinical placements. Students reported witnessing different practices with regards to double gloving which was not in accordance with university teaching. The following quotes were extracted from interviews with students:

> "On the same placement I was taught by one nurse to double glove, take one pair off but I was taught by someone else put one pair on, then take them off, wash your hands and then put a clean pair...I've been told by the university not to double glove..." **(CSS1.S6)**

> "some people (nurses) would double up gloves so that they could remove the top layer..." **(CSS2.S12)**

This was supported by observation data. The following observations were made at both Case-Study Sites:

> When students were advised not to double glove when being taught aseptic technique in wound care in university, they reported observing this in clinical practice **(CSS1.Observation 2-6/1/16, Observation 4-13/1/16**)

> During practice of an aseptic technique in wound care in a simulated community scenario, students reported seeing double gloving in clinical practice and could not see this as a problem as 'gloves might have holes in them' **(CSS2.Observation 1-1/12/16**)

Nurse educators from both Case-Study Sites, were seen to teach students to take extra standard precautions when undertaking an aseptic technique in wound care in the classroom. The following observations were made:

> Students were instructed to wash their hands or use alcohol handrub three times and change their non-sterile gloves and aprons twice after cleaning the trolley prior to opening equipment. Sterile gloves were advised to be used for cleaning the wound and then removed and a new pair used for placement of the dressing **(CSS1.Observation 2-6/1/16).**

> The demonstration of aseptic technique involved three apron changes, one before and after cleaning the trolley, another after removing the dressing and prior to opening equipment **(CSS2.Observation 2-8/1/16)**

7.4 Research Question 5 - What contextual factors influence nursing students' learning and knowledge and skill transfer of aseptic technique in two contrasting cases?

Analysis revealed two main themes to address this research question. The first theme was called 'Influences upon learning and practice of aseptic technique' with three associated sub-themes. The second theme was named 'Relationships, roles and responsibilities to support safe and effective practice' with two associated sub-themes. Each theme and their associated sub-themes will be presented in order.

7.4.1 Theme 1 - Influences upon learning and practice of aseptic technique

This theme identifies the factors that influence nursing students' learning and practice of aseptic technique in the university and clinical practice setting. The three sub-themes were:

- Learning the steps of the procedure versus the principles
- Role models for aseptic technique
- Limited opportunity to learn and transfer skills

Each sub-theme will be presented consecutively.

7.4.1.1 Sub-theme 1 - Learning the steps of the procedure versus the principles

This sub-theme addresses the way in which aseptic technique was reported to be taught to students in university. It also draws upon observation of teaching of aseptic technique by nurse educators in the university setting. Learning the steps of the procedure versus the principles of aseptic technique emerged as a key finding.

Greater focus was placed on teaching students the steps of aseptic procedures in university, rather than the principles. Participants from both Case-Study Sites described rote learning of the steps of aseptic procedures. This appeared to reinforce the belief that any practices which deviated from the steps of the procedure taught in university was wrong or incorrect. The following quotes were taken from interviews with nurse educators and students:

> "In university ...they (nurse educators) talk you through every step of how it (aseptic technique) should be done...I know that we are shown it in practice but it's better for us to learn it in university so we know the right way first rather than just getting shown how to do it in practice and maybe getting it wrong." **(CSS1.S7)**

> "Aseptic is underpinned by principles...we have to break it down in steps to ensure that the students don't miss a step out... so when they have... an OSCE... they know it off by heart..." **(CSS2.HEI2)**

This was supported by observation data. In Case-Study Site 1, in eight of ten observations of teaching and in all four observations of teaching at Case-Study Site 2, a procedural approach was taken. The following is a typical example of an observation of teaching made:

> A step by step approach to teaching aseptic technique in wound care was taken. Some steps were seen to be out of sequence, for example removing apron before disposing of sterile pack **(CSS1. Observation 5-20/1/16)**

This was corroborated by documentary evidence. The following steps of aseptic technique in wound care were demonstrated in accordance with the following handout at Case-Study Site 2:

- Wash hands using 8 step Ayliffe technique
- Don apron
- Open dressing pack and other equipment onto trolley, attach yellow bag to side of trolley, avoiding contamination

(CSS2. Aseptic technique in wound care powerpoint presentation used in Observation 2-8/1/16)

In contrast, two infection prevention nurses from each Case-Study Site recognised the importance of learning the principles. They acknowledge that while the steps of the procedure might vary, the principles remain constant. The following quotes were extracted from interviews:

> "...The actual principles of it (aseptic technique) will never change but the actual way that you might go about it might... when you learn something by the book, some people find it hard to come outside of it..." **(CSS1.IPC11)**

> "People ...think they have to do it (aseptic technique) by rote don't they, so if I don't do it 1,2,3,4,5, then I'm not doing it right whereas really as long as they do the technique and cover everywhere then they will still achieve something at the end of that process that's correct." **(CSS2.IPC 14)**

7.4.1.2 Sub-theme 2 - Role models for aseptic technique

This sub-theme explores the influence of role models for aseptic technique upon students. This includes nurse educators', infection prevention nurses', students' and mentors' perceptions of role models for aseptic technique in clinical practice and in the university. It also draws upon observation of teaching and role modelling in the classroom. A key finding was that nursing students may encounter good and poor role models for aseptic technique in university and clinical placements.

Students from both Case-Study Sites reported observing good and poor aseptic technique in clinical placements. When challenging poor practice, students from both Case-Study Sites described their concerns being dismissed by mentors.

The following are typical quotes taken from interviews with students illustrating the above:

> "I've never felt the need to question...aseptic technique... the way in which they (nurses) do it. I've always thought it was very good." **(CSS2. S 15)**

> "If you're doing like a leg dressing and there's like an open area, and you should have sterile gloves on ...and I said but shouldn't you wear sterile gloves? Oh no, it doesn't matter, it's fine and to me I thought it should be sterile." **(CSS1.S3)**

Students picking up bad habits from their mentors in clinical placements were suggested by nurse educators and infection prevention nurses from both Case-Study Sites. The following quotes were taken from interviews:

> "...Follow your mentor and they (students) pick up bad habits..." **(CSS1.HEI6)**

> "...When they (students) go onto a ward the nurses might be teaching them (students) their bad habits..." **(CSS2.IPC3)**

Students were deemed to have little option but to follow the practices of their mentors. These quotes were extracted from interviews with students and nurse educators at both Case-Study Sites:

> "It can be quite difficult for students: especially if they want to do it (aseptic technique) a particular way or their mentor says no this is the way we do it here." **(CSS2.HEI1)**

> "You (students)...adapt and change to the way your mentor works ... it's definitely the case with aseptic techniques...as people (mentors) do it in all different ways." **(CSS1.S8)**

Conversely, one student at Case-Study Site 2 was adamant that their practice would not be influenced by others. This is demonstrated in the following interview quote:

> "...I'm a bit by the book... I am one of these people that like to do it (aseptic technique) properly. I wouldn't be influenced by somebody; I'm not easily influenced..." (**CSS2.S9)**

Poor role models were evident in university at both Case-Study Sites. The following quotes were taken from interviews with a student and nurse educator:

> ".... It's reviewing ...their (other nurse educators') power points you notice that ...it's (aseptic technique) not with current ...best practice." **(CSS1.HEI6)**

> "There was something wrong on the video in the first year... something that wasn't aseptic." **(CSS2.S14)**

Observation also noted:

> The facilitator contaminated their hands touching the mouse to move onto the next slide in the presentation whilst wearing sterile gloves in the middle of the demonstration. They did draw attention to this and said 'they would not do this' **(CSS2.Observation 2-8/1/16)**

A cascade effect of learning through role modelling in clinical practice was described by nurse educators and infection prevention nurses from both Case-Study Sites. The following quotes were taken from interviews with a nurse educator and infection prevention nurse:

> "...The ward sister is the role model ...depending on ...the ward sister or charge nurses' leadership skills and expectations of the ward...goes down to the band 6's, the staff nurses..." **(CSS1.IPC9)**

> "If they've (mentors) been told something even slightly wrong then that will cascade down and they'll teach it to the next one (student) and the next one and the next one ... and then the new student will teach another student ...and that's how things will just go to pot." **(CSS2.HEI5)**

There was disagreement among participants from both Case-Study Sites about who were the best role models for aseptic technique, experienced or newly qualified nurses. The following are typical quotes obtained from interviews:

> "Nurses with years of experience seem to be the best ... seem to be more at ease with the skill (aseptic technique) and...more accurate..." **(CSS1.HEI3)**

> "Role model ...there is that presumption that somebody that's been doing the job for twenty years ...they're doing it (aseptic technique) the correct way which sometimes isn't the case..." **(CSS2.IPC13)**

7.4.1.3 Sub-theme 3 - Limited opportunity to learn and transfer skills

This sub-theme illustrates the limited opportunity to learn aseptic technique in university as reported by students and nurse educators and witnessed during the observation of teaching. Opportunities for students to learn and transfer their skills (see Chapter 1 for definition) in aseptic technique in clinical placements were also reported to be limited by students and mentors.

Students from both Case-Study Sites reported limited time and opportunity for practice, supervision and feedback upon their performance of aseptic technique in university. The following quotes were retrieved from interviews with students:

> "There wasn't enough time for every student to have a practice ...so the lecturer said if someone was already confident with aseptic technique that to give the time to the other students to have a go..." **(CSS1.S7)**

> "The game of operation (childrens' board game) ...I don't know whether you could do that for aseptic technique...if your clean hand touched a dirty hand then you (as a student) could have a buzzer to go off ...having someone on your shoulder...closer eye ...would help..." **(CSS2.S12)**

This was corroborated by observation data across Case-Study Sites. The following observations were made:

> Students did different parts of the procedure (aseptic technique in wound care), not all students practised it from start to finish **(CSS1 Observation 2-6/1/16)**

> There was one facilitator to 13 students, as a result limited feedback was provided to students during the practice of an aseptic technique in a community wound care scenario **(CSS2- Observation 1-1/12/16)**

Limited time and opportunity for students to gain practice, supervision and feedback upon their performance of aseptic technique in clinical placements was recognised by students across both Case-Study sites. The following quotes were taken from interviews with students:

> "Not having the opportunity to do it (aseptic technique) ...because it depends...where you're placed (clinical placements) as well...I haven't really had...that many opportunities...that's probably where my downfall is..." **(CSS1.S3)**

> "...Having a member of staff to like observe me doing it (aseptic technique) .... I think I'm a student and you (as a mentor) should be observing me." **(CSS2.S15)**

Mentors from both Case-Study Sites perceived time and workload pressures constrained students' opportunity to learn and practice aseptic technique in clinical placements. The following typical quote is taken from interviews with mentors:

> "Time and general pressures definitely may impact on a student nurse's learning...and having the opportunities to do ... aseptic technique" **(CSS2.M10)**

Students and nurse educators at both Case-Study Sites were critical of teaching of aseptic technique in university. In Case-Study Site 1, teaching was criticised for being too focused on teaching the peripheral parts of the procedure (such as preparation of self and trolley) rather than showing how to perform the full

procedure of aseptic technique in wound care. This is illustrated by the following quotes obtained from interviews:

> "They (nurse educators) said...how you put your apron...gloves on... clean the trolley down and that was about it...it (aseptic technique) should be more in depth in university, we (students) should have been taught ...this is how you do it..." **(CSS1.S3)**

> "...Lecturers have recorded how to clean a trolley and the video is like twenty minutes long when really if they'd spent twenty minutes doing the aseptic technique, how to do it, it would have been more beneficial ..." **(CSS1.HEI6)**

This was reinforced by observation data:

> One facilitator spent twenty minutes showing students how to the clean the trolley rather than allowing them to practise an aseptic technique in wound care **(CSS1.Observation 5-20/1/16).**

In comparison, students at Case-Study Site 2 were more damning about the physical learning environment and resources for learning an aseptic technique in wound care. The following is a typical quote retrieved from interviews with students:

> "We (students) haven't all got a trolley each... you're in a classroom with the chairs that have ...a little table on ... the resources don't really fit..." **(CSS2.S13)**

However, observation data revealed limitations of the physical environment and lack of equipment at both Case-Study Sites. The following observations were made:

> Infection prevention precautions were discussed when undertaking an intramuscular or subcutaneous injection but there were no gloves, aprons or hand-washing facilities for the facilitator to demonstrate or students to practice in the classroom. **(CSS1.Observation 1-3/11/16)**

> Practice of female urinary catheterisation took place at a skills station with a manikin, in a room without a sink and students were unable to wash their hands. There was no equipment to clean the trolley and insufficient sterile gloves. **(CSS2. Observation 3-11/3/16)**

The timing and frequency of learning in university was described as influencing nursing students' ability to transfer their skills to clinical practice. Students' opportunity to learn and practice an aseptic technique in wound care in university prior to practising upon patients in placements was variable in Case-Study Site 1. The following quotes were taken from interviews with students:

> "I was taught it (aseptic technique) on placement first because we (students) weren't taught until after our first placement in the university" **(CSS1.S6)**

> "...It (aseptic technique) was ...taught right at the beginning ...in September ... I didn't really put it into practice until the summer of the next year... I've been taught this (aseptic technique) in university but I can't ...remember what I actually have to do" **(CSS1.S5)**

This was supported by observation data from Case-Study Site 1. The following observation was made:

> First year students were observed learning ANTT applied to subcutaneous and intramuscular injection technique only before their first placement **(CSS1. Observation1-3/11/16)**

Students from both Case-Study Sites identified the need to revisit their learning of aseptic technique more regularly throughout the undergraduate programme. The following quotes were extracted from interviews with students:

> "...It (aseptic technique) should be something that we (students) have to re-visit in our course more often..." **(CSS1.S1)**

> "There was such a big gap... we've (students) been shown the aseptic (technique) in the first year...towards the end of the second year when I actually got to really do it (aseptic technique) by myself I was reliant on the mentor talking me through it." **(CSS2.S10)**

Students in both Case-Study Sites felt that simulation in university did not fully prepare them for the realities of performing an aseptic technique upon patients in clinical practice. The following quotes were taken from interviews with students:

> "In university we're (students) taught the ideal situation, we're never taught how to deal with ...anything other than in a hospital...with the patient being ideal, quiet, cooperative patient." **(CSS1.S7)**

> "It's all well and good learning how to do things in a controlled environment where you (as a student) know what's going to happen but when you've actually got a patient there who might move or you are doing it (aseptic technique) behind a curtain in a bed space that's really crowded ... when you're in the classroom setting it's nice and quiet... ideal environment to be doing it in but then to actually go from that to reality" **(CSS2. S13)**

7.4.2. Theme 2 - Relationships, roles and responsibilities to support safe and effective practice

This theme focuses on relationships, roles and responsibilities to support safe and effective aseptic technique practice and has two associated sub-themes. The two sub-themes were:

- Relationships, roles and responsibilities for monitoring and maintaining standards
- Relationships, roles and responsibilities for education and training

7.4.2.1 Sub-theme 1 - Relationships, roles and responsibilities for monitoring and maintaining standards

This sub-theme identifies how standards of aseptic technique in clinical practice are monitored and maintained. Roles and responsibilities for monitoring and maintaining standards of aseptic technique in NHS trusts were found to be blurred.

Mentors and infection prevention nurses' reported limited opportunity to observe and review practices. Aseptic technique was described as a hidden practice by infection prevention nurses and mentors at Case-Study Site 1. The following quotes were taken from interviews:

> *"*I don't really see a lot (of aseptic technique) ...it goes on in the treatment room or behind a curtain..." **(CSS1.IPC5)**
>
> "I don't witness people doing it (aseptic technique) behind the curtains..." **(CSS1.M4)**

There was a lack of clarity about roles and responsibilities for monitoring and maintaining standards of aseptic technique in clinical practice. Monitoring of healthcare professionals' aseptic technique practices in clinical practice did not appear to be well established. Audit of aseptic technique practice was described as new to the role of infection prevention nurses across Case-Study Sites. The following quotes were taken from interviews with infection prevention nurses:

> "...Because of this (ANTT) launch they (The Association for Safe Aseptic Practice) wanted ...to do some audits so we were all (infection prevention nurses) allocated two each but that's the first time I think I've ever done it (audited)." **(CSS1.IPC11)**

> "...We're (infection prevention nurses/team) just starting off ...auditing aseptic practice from scratch..." **(CSS2.IPC13)**

One infection prevention nurse at Case-Study Site 2, was vague about the audit of aseptic technique practice in their NHS trust. This is captured in the following interview quote:

> "Team leaders go out and monitor (aseptic technique) but I don't think there's that much of that (peer audit) goes in the community that's something I'd have to follow up, I'd be sort of guessing I think if I answered that." **(CSS2.IPC13)**

Documentary evidence identified infection prevention nurses in this NHS trust as being responsible for the audit of aseptic technique practice. The following extract is taken from the Asepsis Policy in the NHS trust written by the same infection prevention team:

> Implementation of the Asepsis Policy in practice by peer audit by infection control nurses/specialist nurse every two years as a minimum **(CSS2.G Asepsis policy)**

Infection prevention nurses across Case-Study Sites gave conflicting views about whose role and responsibility it is for maintaining standards of aseptic technique in clinical practice. The following quotes are taken from interviews with infection prevention nurses:

> "...Should be perhaps the role of the ward manager to ensure that all staff are complying and...competent ... (in aseptic technique) **(CSS1.IPC7)**

> "It's down to practitioner and student ...to ensure that the (aseptic) technique...practice is up to standard because things do change all the time..." **(CSS2.IPC1)**

7.4.2.2 Sub-theme 2 - Relationships, roles and responsibilities for education and training

This theme illustrates the relationships, roles and responsibilities for education and training in aseptic technique. A key finding was that there were no clear relationships, roles and responsibilities for aseptic technique education and training. There appeared to be no joint working or interaction between universities and NHS Trusts with regards to education and training in aseptic technique.

Good relationships were reported between universities and NHS Trusts across both Case-Study Sites. Practice facilitators were seen to be the link between universities and NHS Trusts. The following quotes were extracted from interviews with mentors and infection prevention nurses:

> "Good (relationship), we've got practice facilitators they are actively out in the clinical environment approaching mentors... student nurses and offering their help and guidance whenever they're needed" (**CSS1.M5)**

> "...It is a strong relationship...the practice facilitator team do tend to have more to do with the university than we do as the infection control team ...they have to go into university for updates on what they're being taught at university so I think they (university and NHS trust) do have a good relationship..." **(CSS2.IPC4)**

Some infection prevention teams perceived better links with universities where there was a joint appointment or a nurse consultant within the team. The following quotes were taken from interviews with infection prevention nurses:

> "There isn't that formal relationship ...we (the infection prevention team) don't regularly link up with the university ... "**(CSS1.IPC7)**

> "The links are definitely there; I wouldn't necessarily say they're very strong...we (the infection prevention team) have got contacts with the university...we've got other infection control colleagues who are university lecturers..." **(CSS1.IPC10)**

Students at Case-Study Site 1, described nurse educators who taught aseptic technique as removed from clinical practice. In comparison, students at Case-Study Site 2, perceived that they were taught aseptic technique by nurse educators who still worked in clinical practice. These typical quotes were taken from interviews with students:

> "...Tutors that have taught me (aseptic technique) ...haven't been out in practice for a while...so perhaps that's where a bit of the discrepancy comes in..."**(CSS1.S5)**

> "...The one (nurse educator) that I was taught (aseptic technique) by.... was both a lecturer and still working at the hospital...there was a few of the educators were ...still practising..." **(CSS2.S9)**

Qualified nurses working in NHS trusts from both Case-Study Sites lacked insight into what students are taught about aseptic technique in university. Typical quotes taken from interviews from infection prevention nurses and mentors are presented below:

> "I would like to know...how their (students) aseptic technique is taught." **(CSS1.M1)**

> "... It's (this study) made us (the infection prevention team) think that we will go in and see what (aseptic technique) practices they are teaching and we have tried before to get in the universities...and it's just never happened, whether we haven't fought hard enough to get in there **(CSS2.IPC14)**

Infection prevention teams across both Case-Study Sites lacked input into nursing students' education and training in aseptic technique in university and clinical placements. The following quotes were taken from interviews with infection prevention nurses:

> "We (infection prevention teams) rarely get them (students). I thought there would have been more visits to infection control..." **(CSS1.IPC8)**

> "...Thirty years ago, now, we (infection prevention nurses) used to go out to the university and give lectures to the student nurses but that stopped..." **(CSS2.IPC3)**

Infection prevention nurses across Case-Study Sites perceived they had a limited role in aseptic technique education and training for qualified health professionals. In Case-Study Site 2, infection prevention nurses had mixed views about the best way to deliver education and training in aseptic technique. The following quotes were taken from interviews:

> "Everything seems just ...so fragmented... (In our organisation) we've got IV practitioners that teach the IV (intravenous) stuff and then we've got a urology nurse specialist that teaches male catheterisation..." **(CSS2. IPC3)**

> "The training of it (aseptic technique) is a stand-alone...what we're (the infection prevention team) trying to do...we have the practice development nurses... integrate it (aseptic technique) into their sessions...put it through each bit of practice that they do... so it's not stand alone." **(CSS2.IPC14)**

Infection prevention teams appeared to have different roles and responsibilities in the leadership of ANTT in NHS Trusts across Case-Study Sites. This is illustrated by the following quotes taken from interviews with infection prevention nurses:

> "The infection prevention and control team are leading it (ANTT)... "(**CSS1.IPC7)**

> "My manager doesn't want the infection control lead team to lead on ANTT in this Trust...she felt ...A) She'd want to do it (aseptic technique)

justice and B) She didn't believe it (aseptic technique) was just an infection control issue, ...it was ...education..." **(CSS2.IPC2)**

7.5 Summary

The Case- study sites were found to be similar despite their being selected as contrasting cases, with one site identified as demonstrating greater innovation in educational practice. Confusion and lack of understanding of aseptic technique was widespread in practitioners, educators and students across case- study sites. The only discernible differences were in students' confidence in competency levels, opportunity to practice aseptic technique in wound care prior to their first placement and belief in their ability to perform aseptic technique in the domiciliary environment. These differences may be attributed to the teaching of aseptic technique. Teaching of aseptic technique in university was found to be sub-optimal, focusing on the trivia and reinforcing the steps rather than principles of aseptic technique. Students were exposed to poor role models and had limited opportunity to learn, practice and receive feedback on their performance of aseptic technique in both the classroom and during clinical placements.

The university and clinical practice did not function as one 'community of practice'. Disparity between what was taught in the classroom and practised in clinical practice was evident. There was a lack of clarity surrounding roles and responsibilities for education, training and monitoring of aseptic technique in clinical practice. The case-study findings suggest much improvement is needed in nursing students' education and training in aseptic technique.

The phase two case-study findings will be discussed together with the phase one survey findings in the next chapter.

Chapter 8 - Discussion

8.0 Introduction

The chapter will discuss the findings of this mixed methods study. The phase one survey and phase two case-study findings, each of which answer different research questions are presented together to address the research aim. The aim of this study was to investigate nursing students' learning of aseptic technique in pre-registration programmes in the UK.

8.1 Contribution to knowledge

This study makes a unique contribution to nurse education. This is the first study to explore nursing students' education and training in aseptic technique, a fundamental infection prevention practice. This study explored when, what and how aseptic technique is taught and assessed in different organisations, with an in-depth analysis of two case-study sites chosen for their reported differences in approaches to teaching and assessment. This study explores the context of learning and multiple viewpoints of nurse educators, infection prevention nurses, mentors and students. It responds to policy campaigns for improvements in healthcare professionals' infection prevention practices to reduce HCAI and risks of antimicrobial resistance (DoH 2014; O'Neill 2016; WHO 2016a; WHO 2016b; DoH 2019).

8.2 Outline of the chapter

This chapter begins by providing an overview of the study findings. A discussion of the effectiveness of the research methodology and methods in meeting the research aim follows. The key research findings and their implications from each phase of the study are then discussed under each of the six research questions. The theoretical propositions of the case-study are revisited under research questions five and six. The limitations of the study and wider implications of the findings for education are then discussed. Recommendations for nursing practice, education and research are finally made and the thesis concluded.

8.3 Overview of the findings

Aseptic technique is a core nursing skill (NMC 2010; NMC 2018; Nursing and Midwifery Board of Australia 2013; Gonzalez and Sole 2014) and infection prevention practice recognised by national and international policy as central to

patient safety (DoH 2003; 2014b; WHO 2016a; 2016b). Lack of understanding of the principles of aseptic technique and what was meant to be achieved among educators and practitioners emerged as an important serendipitous finding. Confusion was widespread not just in students and nurses practising aseptic technique (Davey 1997; Hallett 2000; Gould et al. 2017a), but also in infection prevention specialists and educators considered to be experts. The importance of aseptic technique was often underplayed by qualified nurses. This study found teaching and assessment of aseptic technique substandard, with much scope for improvement. In light of these findings, there is need for immediate action to review the teaching and assessment of aseptic technique. Practitioners and students require greater opportunity for education, training and assessment of aseptic technique if patient safety is to be protected (DoH 2003; 2014b; WHO 2016a). The findings of this study have wider implications for teaching other core skills in nurse education. Teaching of other core skills in the undergraduate curriculum may be equally poor.

Despite its importance in patient safety, aseptic technique has been under researched in qualified nurses (Bree-Williams and Waterman 1996; Hallett 2000; Unsworth and Collins 2011; Gould et al. 2017a) and students (Davey 1997; Gonzalez and Sole 2014). In contrast, extensive research has investigated the effectiveness of education in improving qualified nurses' and students' hand hygiene (Salmon et al. 2013; Baggett et al. 2014; Gould et al. 2017c).

A key finding of the study was lack of an accepted definition of aseptic technique. Numerous definitions of aseptic technique exist in the literature (Xavier 1999; Wilson 2006; Hart 2007; Flores 2008; NICE 2012); following review no perfect definition could be identified (see Chapter 2). Definitions reviewed came from e-learning (Baillie 2014), clinical textbooks (Dougherty and Lister 2011), and guidelines (Loveday et al. 2014; ASAP 2016) later identified in the phase one survey as used in university teaching. In the absence of a universally accepted definition, there is uncertainty about what is to be achieved when undertaking an aseptic technique and what is being practised and taught. Developing a common understanding of aseptic technique and what it intends to achieve is critical for enhancing policy, education and practice. Policy makers rely on the literature to inform policy and guidelines used by qualified nurses to guide clinical practice (Fretheim et al. 2006; Carthey et al. 2011; Clancy et al. 2012). Inevitably, confusion and variations in the practice of aseptic technique

will endure if no consensus is reached about what aseptic technique is and what it aims to achieve.

The educational practice reported by educators in the phase one survey was not found to be a reliable indicator of educational practice at the Case-Study Sites in the phase two case-study. The Case-Study Sites chosen for apparently being contrasting cases, Case-Study Site 2 for reporting better educational practice than Case-Study Site 1, had similar educational practices. Self-reported educational practice by a single educator in the phase one survey may have culminated in socially desirable responses, as identified by Bryman (2016). These findings illustrate the challenge in gaining the 'truth' or realities of educational practice, not just for aseptic technique. Enhancing education and training in aseptic technique (DoH 2003; 2014b; WHO 2016a) may be difficult to achieve if educators do not perceive a need for improvement. Recognising good educational practice and where improvements are required is important in advancing nurse education.

8.4 Effectiveness of the methodology

The effectiveness of Social Learning theory (Bandura 1977) and Communities of Practice theory (Wenger 1998) as the theoretical framework underpinning the study will be discussed. Role modelling, a key component of Social Learning theory (Bandura 1977) proved helpful in understanding the behaviour of qualified nurses as teachers and role models and students as learners. In this study, role models for aseptic technique in university and clinical placements influenced students' learning. Behaviourist approaches to learning aseptic technique were reinforced in university teaching. Students were taught and encouraged to learn the steps of aseptic procedures through imitation, modelling and reinforcement in simulation (Bandura 1977). Learning of aseptic technique was influenced by the relationship between the observer and model, the perceived value of the behaviour and frequency of the modelled stimuli. The study findings showed that students responded differently when observing good and poor role models for aseptic technique in clinical practice, corroborating the findings of Ward's (2010) study. Students consciously chose whether or not to follow their mentor's practices. Mentors' response when practices were challenged by students influenced students' learning. Dismissing students' concerns about breaches in aseptic technique may reinforce poor practice and threaten patient safety (DoH 2003; 2014b; WHO 2016a; 2016b).

The Communities of Practice theory (Wenger 1998) was valuable in exploring socio-cultural influences upon learning. The university and clinical placements were conceptualised as separate 'communities of practice' in the theoretical propositions of the case-study which was confirmed by the study findings. Returning to the definition of a 'community of practice' (Wenger 1998) (see Section 5.3.2), practitioners and educators did not behave as though they were part of the same community of practice. Educators and practitioners did not function as a group with shared understanding and practice of aseptic technique who deepen their knowledge and expertise through regular interaction (Wenger 1998), corroborating the findings of earlier studies (Ward 2010; Cox et al. 2014). Policy recommendations for collaboration and sharing of knowledge between practitioners and academics (DoH 2014; WHO 2016a) have therefore not been achieved. A 'community of practice' for aseptic technique did not even exist within each university. In this study, qualified nurses had their own understanding and practices based upon initial training and what was believed to be important. There was a lack of continuity in the teaching of aseptic technique. Students were exposed to much variation, leaving them uncertain about how to proceed with an aseptic technique. Students as newcomers in different clinical placements adopted their mentors' practices in order to belong and become part of the community of practice. Some students described constantly transforming their aseptic technique practices.

8.5 Effectiveness of the methods

The effectiveness of the study design and sampling in terms of the transferability of the findings and completeness of data will be explored.

8.5.1 Effectiveness of the study design

Use of a mixed methods study design was novel. Earlier studies were either quantitative studies (n=20), using pre and post-test (Watts et al. 2009) or cross-sectional designs (Stayt and Merriman 2013) or qualitative studies (n=8) (Davey 1997) (see Chapter 4). A mixed methods, explanatory sequential study (Creswell and Plano Clark 2011) was effective for addressing the research questions. The phase one survey allowed for a broad understanding of what, when and how aseptic technique is taught and assessed across pre-registration programmes. The phase two case-study gave a real insight into what was being taught and assessed at two Case-Study Sites. Use of a single method or a

different mixed methods study design with qualitative and quantitative strands occurring concurrently rather than sequentially (Creswell and Plano Clark 2011) would have prevented follow-up of the phase one survey findings. The importance of follow-up was shown by finding that the contrasting Case-Study Sites used similar teaching and assessment methods. Use of innovative educational practices (e.g. virtual reality) and formative and summative assessment reported in the phase one survey were not apparent at Case-Study Site 2. The simulation facilities and resources in Case-Study Site 2 were more inferior, multi-use classrooms without camera technology compared to Case-Study Site 1 which had a designated 'ward like' simulation facility with cameras.

Data triangulation was achieved in the study. Multiple sources of data: observation, interviews and documentary evidence supported the study's findings, increasing the construct validity of the case-study (Yin 2014). Methodological triangulation (Tashakkori and Teddlie 2003; Creswell and Plano Clark 2011) was accomplished to some extent, but limited by restricted access to observation at one Case-Study Site. Some of the phase one quantitative survey findings corroborated the phase two qualitative case-study findings.

8.5.2 Effectiveness of the sampling

8.5.2.1 Transferability of the findings

The phase two Case-Study findings may be transferable to other universities and associated NHS trusts. The Case-Study Sites were typical of all NMC approved pre-registration programmes in the UK. Phase one survey data showed that a programme of three years' duration with two intakes of students per academic year was typical of the majority of programmes. At the time of conducting the study, all pre-registration programmes were required to meet the same NMC standards and programme requirements (NMC 2010) which have since been superseded by the Standards for pre-registration nursing programmes (NMC 2018). Programmes consisted of at least 4,600 hours, with 50% theory and 50% practice hours (NMC 2010). Universities and clinical placements were all subject to regular monitoring against the same quality assurance standards (NMC 2010). Students were supervised and assessed in clinical placements and simulation, by mentors prepared for assessment (NMC 2010). It was a requirement that the NMC Essential Skill Clusters must be incorporated into all programmes. Students were required to achieve the same

competencies for aseptic technique upon entry to the register (NMC 2010). The learning, teaching and assessment methods used for aseptic technique in the Case-Study Sites were typical of those reported in the phase one survey.

8.5.2.2 Data Collection

Retrieving documents and gaining access to observe university teaching was difficult. In the phase one survey, virtual learning platforms restricted respondents' access to some teaching materials. Teaching materials used in observed teaching sessions were either viewed and/or a copy provided. In the phase two case-study most NHS Trusts shared relevant policies. In Case-Study Site 1, different module leaders were contacted to gain access to observe teaching sessions; some were more responsive than others. In Case-Study Site 2, the senior lecturer for clinical skills was the gatekeeper for gaining access to teaching sessions. There was disparity in the observation of teaching across Case-Study Sites. In Case-Study Site 1, teaching sessions were observed on more than one occasion whereas in Case-Study Site 2, most teaching sessions were observed on one occasion. No comparisons could be made between different facilitators undertaking the same teaching session at Case-Study Site 2. The gatekeeper at Case-Study Site 2 confessed that academic staff were apprehensive about being observed, an important finding which might apply to the teaching of other skills. The key findings will now be discussed under each research question.

8.6 Research Question 1 - When is aseptic technique taught in pre-registration nursing programmes in the UK?

This study provides an understanding of when aseptic technique is taught in pre-registration programmes in the UK since the introduction of NMC Essential Skills Clusters (NMC 2010). The findings in relation to what year aseptic technique is taught and applied to different clinical procedures in programmes will be discussed in turn.

8.6.1 Years of programmes when aseptic technique is taught

This study found aseptic technique to be an integral part of the curriculum, taught across all years of pre-registration programmes. All nursing students must acquire the necessary knowledge, understanding and skills to be competent upon entry to the register (NMC 2010; NMC 2018). All forty-nine universities returning phase one survey data reported aseptic technique was

addressed during year one and revisited each year in the majority of pre-registration programmes. Students need to be prepared for infection prevention prior to clinical placements and build upon their knowledge and skills throughout the programme (Ward 2011; Hinkin and Cutter 2014). The phase one survey findings suggested use of a spiral curriculum approach (Bruner 1960). A spiral curriculum allows students to revisit aseptic technique, repeatedly building upon their knowledge and skills throughout the programme with increasing complexity, until understanding and mastery has been achieved (Chambers et al. 2013). In contrast, students in the phase two case-study findings gave conflicting views of aseptic technique teaching being delivered in a fragmented and piecemeal fashion. These findings imply that students may not have achieved a full understanding and mastery of aseptic technique by the time they enter the workforce as a qualified nurse, placing patients at risk. Students had different perceptions of education and training in aseptic technique to that of educators. It is therefore imperative that there is consultation with students regarding any improvements that need to be made to undergraduate education and training in aseptic technique. More research is required into whether a spiral curriculum approach for aseptic technique and other core skills is being used in pre-registration programmes.

8.6.2 When aseptic technique is applied to different clinical procedures in programmes

The phase one survey found aseptic technique was taught applied to different types of clinical procedures across different years of the programme, corroborating earlier studies (Melby et al. 1997; O'Neill 2001; Jeffries et al. 2002; Watts et al. 2009; Gonzalez and Sole 2014; Uysal 2016). Earlier studies did not intend to establish when aseptic technique was taught but tested the effectiveness of different teaching strategies upon the development of students' aseptic technique skills in single universities. This study provides greater understanding of when aseptic technique is taught applied to particular clinical procedures across programmes.

In the phase one survey, aseptic technique was reported to be more widely taught with application to wound care than any other clinical procedure in pre-registration programmes. Greater focus upon teaching aseptic technique in wound care might be at the expense of teaching aseptic technique in other invasive procedures. Aseptic technique was most commonly taught applied to

wound care and injection technique in the first year and to urinary catheterisation and care of intravenous infusions/devices in the second year. The findings of this study cannot be directly aligned with the findings of earlier studies. However, a greater number of earlier studies have focused upon developing first year students' aseptic technique skills in wound care and injection technique than in any other year or clinical procedure (O'Neill 2001; Jeffries et al. 2002; Wright et al. 2008; Watts et al. 2009). Nurse educators associating teaching of aseptic technique more with wound care than other clinical procedures might have affected reporting in the phase one survey, corroborating the phase two case-study findings and Gould et al.'s (2017b) findings. In Gould et al.'s (2017b) survey of qualified nurses' (n=180) understanding of aseptic technique, nurses most often referred to the use of aseptic technique in wound dressings. There is concern that nurses may overlook the need for aseptic technique in other invasive procedures.

Students may be taught aseptic technique with application to wound care and injection technique early in programmes as these are clinical procedures which are most likely to be encountered during clinical placements (Davey 1997; Stayt and Merriman 2013). In this study, aseptic technique was taught applied to different clinical procedures with increasing complexity and spread out in programmes. As a consequence students were ill prepared to undertake an aseptic technique in all types of clinical procedures prior to clinical placements. Students' first opportunity to undertake an aseptic technique may be upon patients in clinical practice rather than in the safety of the simulated environment, which has implications for patient safety. Educators are unable to control when students might encounter clinical procedures which require an aseptic technique during clinical placements but they can control when students are exposed to certain aseptic procedures through simulation.

8.6.3 Summary

The preparation of students in aseptic technique prior to clinical placements needs to be improved. Education should help students to recognise the full range of clinical procedures that require an aseptic technique. Furthermore, this preparation should facilitate students learning of the principles of aseptic technique which can be applied in any clinical procedure and care setting at the beginning of their programmes to protect patient safety.

8.7 Research Question 2 - What is taught about aseptic technique in pre-registration nursing programmes in the UK?

This study explores what is taught about aseptic technique across pre-registration programmes in order to establish how education and training might be improved to reduce HCAI and risk of antimicrobial resistance (DoH 2003; 2014a; 2015b; WHO 2016a) which is now becoming increasingly important. The key findings in relation to the principles of aseptic technique taught to students and the guidelines used to underpin teaching of aseptic technique will be discussed.

8.7.1 Principles of aseptic technique taught to students

The phase one survey findings suggest students may be taught inaccurate material by nurse educators. Nurse educators, when asked what principles of aseptic technique were taught, often described professional standards, components of an aseptic procedure and generic infection prevention precautions/knowledge instead. Six out of forty different responses from nurse educators were identified as principles of aseptic technique based on Lister's fundamental principle of preventing contamination of susceptible sites (Ayliffe and English 2003) (see Chapter 2). These findings suggest that teaching of aseptic technique is more competency and procedure driven than principle driven. Of the six principles identified by nurse educators, a non-touch principle was most common. Six principles are excessive given there is only one fundamental principle of aseptic technique. However, this is almost half the number nursing students were expected to learn in Davey's (1997) study exploring students' understanding of aseptic technique. This study established that there is much discrepancy in the principles of aseptic technique taught to students by nurse educators across pre-registration programmes.

The findings of this study suggest improvements in teaching principles of aseptic technique are needed. Learning one fundamental principle is easier than students having to learn and recall multiple principles. The more stages there are, the harder it is for students to learn aseptic technique. The literature and teaching of aseptic technique do not help to clarify principles of aseptic technique for students. Students cannot be expected to know and be able to apply the principles of aseptic technique if educators are unable to do so.

Nurse educators' inability to identify principles of aseptic technique is of grave concern for nurse education and practice. Nurses have the closest contact with patients and are the largest professional group (WHO 2018). Aseptic technique may be undertaken by nurses, almost every day in a range of settings (Aziz 2009; Rowley and Clare 2011; Gould et al. 2017a). Sub-optimal knowledge, understanding and practices of aseptic technique by nurses threatens patient safety, increasing the risk of infection to patients, staff and others (DoH 2003; WHO 2016a).

Educators have a professional and ethical responsibility to teach aseptic technique, a core skill, accurately (NMC 2010; NMC 2018). If nurse educators who teach students have poor understanding of the principles of aseptic technique this will be passed onto students who are expected to apply the principles and safely perform aseptic technique (NMC 2010; NMC 2018). Substandard teaching of aseptic technique may lead to poor preparation of future nurses providing direct patient care and as leaders or champions of infection prevention (Marra et al 2010; RCN 2014; DOH 2014; The Health Foundation 2015; Zingg et al 2015).

If educators cannot teach aseptic technique accurately, this may be true of other core skills and aspects of the curriculum. Aseptic technique is not the only core skill in nurse education where there has been call for educational improvements (Chant et al. 2002; Connell et al. 2016; Maclean et al. 2017; McDonald et al. 2018). This study adds to the increasing body of knowledge about how core clinical skills are taught.

Aseptic technique is taught to other healthcare professional students and there is evidence to suggest, that as in this study, it may be sub-optimal (Jackson et al. 2012). In Jackson's (2012) mixed methods study exploring the effectiveness of medical students' training in aseptic technique, performance had significantly deteriorated ten weeks after training. The findings of this study support the need for a review of the principles of aseptic technique that are taught to healthcare professional students. Inaccurate teaching of the principles of aseptic technique might be more widespread amongst healthcare professional groups.

8.7.2 Use of guidelines to underpin the teaching of aseptic technique

In the phase one survey, either two or three different guidelines were reported to underpin university teaching of aseptic technique. The Royal Marsden Clinical Nursing Procedures guidelines (Dougherty and Lister 2015) were most widely used by universities. Approximately half of universities identified use of ANTT guidelines (ASAP 2016). This finding suggests that students may be taught aseptic technique differently. However, no relationship was found between reported use of ANTT guidelines and identification of ANTT specific principles e.g. protecting key parts and sites by phase one survey respondents. This finding might be due to poor recall of ANTT principles by respondents. Another explanation is that many aspects of the ANTT approach are not novel, for example the use of a non-touch technique. The reason why some universities and not others have adopted ANTT cannot be established from the survey. Educators may not be as up to date with national infection prevention guidelines which mention ANTT (Loveday et al. 2014; NICE 2017), as they should be, which might apply to guidelines for other core skills.

The ANTT guidelines are free but only available upon request from the ANTT website (ASAP 2018), which might influence the uptake of ANTT by universities. Multiple guidelines and poor accessibility of guidelines have been identified as influencing healthcare professionals' compliance with policies and guidelines (Carthey et al. 2011). Multiple guidelines for aseptic technique may cause confusion and uncertainty among healthcare professionals and students about which guidelines should be followed. Use of multiple guidelines may also lead to variations in the practice of aseptic technique which has been previously reported (Aziz 2009). The findings of this study may have implications for the use of guidelines in teaching other clinical skills.

No previous study has examined guidelines underpinning teaching of aseptic technique in pre-registration programmes. This study establishes the use of ANTT guidelines by universities since the introduction of ANTT (Rowley 2001). ANTT, originally conceived to standardise healthcare professionals' aseptic technique, may have overlooked targeting universities to implement ANTT in pre-registration programmes. Any attempt to standardise aseptic technique practice is futile without targeting both qualified nurses and undergraduate students who are embarking on their careers with regards to the use of these guidelines. The phase two case-study findings confirm standardisation of aseptic

technique has not been achieved at the two Case-Study Sites (see Sections 5.8.3). Improving infection prevention practices may be challenging with healthcare professionals justifying deviations from infection prevention policies and guidelines (Jackson et al. 2014; Shah et al. 2015). Improving other nursing practices may be similarly challenging.

8.7.3 Summary

The findings identified that there is much inconsistency and inaccuracy in what may be taught about aseptic technique to nursing students across undergraduate programmes. Undergraduate education and training in aseptic technique is sub-optimal and does not provide confidence that what students are taught will provide a solid foundation for nurses to reduce HCAI and tackle antimicrobial resistance. A review of education and training in aseptic technique is required as a matter of urgency.

8.8 Research question 3 - How is aseptic technique taught in pre-registration nursing programmes in the UK?

This study investigates how aseptic technique is taught across pre-registration programmes in the UK. The key findings in relation to the amount of time spent teaching aseptic technique, and teaching and feedback methods used across programmes will be discussed.

8.8.1 Amount of teaching related to aseptic technique provided in undergraduate programmes

The phase one survey reported wide variation in time spent teaching aseptic technique in university across programmes. Total teaching time ranged from 3 to 64 hours, with a mean time of 20 hours across programmes. The amount of time reported teaching aseptic technique across programmes in this study appears higher than in Carter et al.'s (2017) study investigating the relationship between hours of infection prevention education and nursing students' knowledge, attitudes and skills in the United States of America. Carter et al. (2017) reported 66% of students receiving between one to eight hours of aseptic technique education and 27% in excess of 8 hours, but the exact time is unknown. In this study, nurse educators reported total time spent in university teaching of aseptic technique in each programme. In comparison, Carter et al.'s (2017) findings

relied upon many students who had not completed their programme accurately recalling hours of aseptic technique education received. This study increases understanding of time spent teaching aseptic technique across whole programmes in the United Kingdom and by gaining an educators' perspective.

The findings of this study suggest greater time is spent teaching aseptic technique in some programmes than others. Some programmes placing more importance upon teaching aseptic technique than others. Aseptic technique should have the same priority across all programmes (DoH 2003; DoH 2014; O'Neill 2016; WHO 2016a). Students may have less time than others to develop their knowledge and skills despite having to achieve the same competencies by the end of programmes (NMC 2010). The findings raise questions about how much time should be devoted to teaching aseptic technique as compared to other topics included in the curriculum and who should make these decisions. Increasing time for teaching of aseptic technique in programmes is likely to be at the expense of other content as time is finite. Increasing the teaching time would be counterproductive without improving the quality of teaching first. There would be no value in providing more time for learning aseptic technique if what is taught is inconsistent and confusing to students.

As educators, the focus should be upon the quality of the teaching/learning experience rather than the quantity of time spent teaching. However, nurse educators in this study wanted more time for teaching aseptic technique in university. Similarly, students stated they wanted more time for learning and practising aseptic technique in the phase two case-study. Both students and educators therefore expressed dissatisfaction with the available teaching time, supporting the need to review this. The size of programmes in this study had no bearing upon teaching time. Increasing student numbers together with ever increasing curriculum content, may limit time for meaningful learning of concepts (Dalley et al. 2008; Deane and Asselin 2015) such as aseptic technique.

Time spent teaching other core skills in pre-registration programmes should be investigated. The phase one survey reported a downward trend in direct teaching time and inverse relationship in indirect teaching time (simulation/independent practice) from the first to third year indicating movement away from didactic teaching towards student centred learning approaches at the point of registration. Students may enter the workforce, without opportunity to

consolidate their aseptic technique knowledge and skills, prior to independent practice.

8.8.2 Use of different teaching methods

A blended learning approach was apparent in universities. Simulation was the most common teaching method reported by 86% of phase one respondents followed by lectures (78%), corroborating Carter et al.'s (2017) findings. Similarly, students in Carter et al.'s (2017) survey reported receiving most aseptic technique education in simulation (63%) and lectures (21%) but lower figures compared to this study may be due to reporting differences. In Carter et al.'s (2017) study, not all students had completed their programmes and only the location of education was reported. In this study, nurse educators provided a whole programme view of teaching methods used by universities. A blended learning approach using simulation and lectures, helps to support students to learn both the underlying theory and practical skills of an aseptic technique.

Provision of a video (76%) or live (90%) demonstration of aseptic technique by universities was commonplace. No prior study has investigated the use of different types of demonstrations in supporting the teaching and learning of aseptic technique across programmes. Earlier studies have either explored the effectiveness of facilitator demonstration in nursing students' learning of aseptic technique during intramuscular injections and produced weak findings (Melby et al. 1997) or compared facilitator demonstration to video or online demonstrations in clinical skills which were found to be just as effective as a facilitator demonstration (Kelly et al. 2009; Holland et al. 2013; Forbes et al. 2016b). A combination of the use of a live and video demonstration of aseptic technique as found in this study is recommended. Students have the ability to ask questions during a live demonstration and revisit the video demonstration on multiple occasions as required.

There was high expectation for students to prepare before taught sessions by 94% of universities reported in the phase one survey. Pre-reading (93%) and e-learning (78%) were most commonly reported by phase one survey respondents. There was a high dependency on self-directed learning which if not completed by students or drawn upon during teaching may limit its effectiveness .Greater reliance upon self-directed learning in larger programmes was expected, however, programme size had no influence. This study

establishes the different types of self-directed methods used for learning aseptic technique across programmes. Earlier studies provide insight into the effectiveness of self-directed methods in single universities.

In Davey's (1997) study, students required to undertake pre-reading had incomplete understanding of aseptic technique. Previous studies exploring the effectiveness of e-learning for infection prevention (Reime et al. 2008; Bloomfield et al. 2010) and aseptic technique (Jeffries et al. 2002; Walsh et al. 2011) have found it to be no less or more effective than face to face teaching. Similarly, systematic reviews have reported limited effectiveness of e-learning for clinical skills and in nurse education (Bloomfield et al. 2008; Voutilainen et al. 2017). There is a risk that e-learning might promote surface rather than deeper learning of aseptic technique (Quinn and Hughes 2013). E-learning in combination with other teaching methods as found in this study is therefore preferable in developing students' knowledge, understanding and skills in aseptic technique. However, the accuracy of e-learning commonly used by universities (see Chapter 2) and teaching of aseptic technique needs to be addressed for effective learning.

8.8.3 Methods of feedback on performance

In this study, objective methods of feedback upon students' performance of aseptic technique were not commonplace. In the phase one survey, approximately a fifth of universities reported recording students' practice of aseptic technique. Self-assessment and facilitator feedback on students' performance were more widely reported by universities. This study reports upon the use of different methods of feedback on students' performance of aseptic technique across programmes. Earlier studies have explored the effectiveness of self-review of video recorded performance of aseptic technique by students and produced mixed findings (O'Neill 2001; Watts et al. 2009).

In O'Neill's (2001) pre-post-test study students who analysed their videotaped performance of aseptic technique demonstrated significant improvements in performance and greater accuracy in self-assessment than those relying on memory recall. In Watts et al.'s (2009) evaluative study of self-assessment using videotapes in psychomotor skill development, teaching staff identified two to three times higher the number of breaks in aseptic technique during a wound dressing than students.

Video feedback has found to be effective in the development of other skills (vital signs and communication) and in other healthcare students (Yoo et al. 2009; Hawkins et al. 2012). Review of video performance in conjunction with other feedback methods provides students with multiple sources of feedback. Multiple sources of feedback in measuring clinical competency is growing (Cormack et al. 2018). In the phase two case-study, students wanted greater feedback upon their performance of aseptic technique. Video and other technologies may help in the provision of objective, immediate feedback on students' performance of aseptic technique. Improving feedback to students on their practical performance of aseptic technique is vital for increasing self-awareness of breaches in aseptic technique and enhancing the standard of practice.

8.8.4 Summary

Discrepancy across programmes and dissatisfaction among educators and students with time for teaching aseptic technique demands a review of educational provision. The blended learning approaches used to teach aseptic technique should support the needs of nursing students, a diverse range of learners with different learning needs. More objective methods of feedback upon students' performance of aseptic technique may be influential in improving competency in aseptic technique.

8.9 Research question 4 - How is aseptic technique assessed in pre-registration nursing programmes in the UK?

This study has explored how aseptic technique is assessed in university and clinical practice across pre-registration programmes. The next sections will discuss the key findings in relation to the opportunity, frequency and methods of competency assessment for aseptic technique.

8.9.1 Opportunity for competency assessment

This study found students may have limited opportunity for competency assessment of aseptic technique in pre-registration programmes. In the phase one survey, less than a third (27%) of universities reported summative assessment of students' performance of aseptic technique in university. These findings support the claims that aseptic technique once assessed in nursing training in the UK has been lost (Takahashi 2000; Unsworth and Collins 2011;

Gould et al. 2017a). Educators in many universities will therefore not have the benefit of an assessment to establish their students' level of competency in aseptic technique. An OSCE/OSCA was the most common assessment method, requiring considerable resource for universities in terms of staffing, equipment and facilities (Rushforth 2007; Sola et al. 2017). Increasing numbers of students and the resource intensiveness of OSCE assessment might explain why summative assessment of aseptic technique has been lost from programmes. This begs the question as to what drives the decisions to assess different knowledge and skills in undergraduate programmes. These decisions should be based on assessing what is of greatest importance and what has the greatest level of risk or costs to patients. However, this argument could be applied to a number of core skills.

Nearly a third (32.6%) of nurse educators wanted inclusion of a university based summative competency assessment of aseptic technique in programmes. These findings suggest much dissatisfaction with university based assessment of aseptic technique among educators, which might apply to other core skills. Yet educators are best placed to change this, and include a summative assessment of aseptic technique in programmes. There is a need to examine the reasons why educators, despite a strength of feeling that a university based summative assessment is important, feel disempowered to address this. It may be that they are looking for a compulsory directive from the NMC.

The findings of this study suggest reliance upon summative assessment of students' competency by mentors in clinical placements. Earlier studies have criticised qualified nurses' aseptic technique practices for being confused and variable for some time (Bree-Williams and Waterman 1996; Hallett 2000; Rowley 2001; Aziz 2009; Unsworth 2011). Students may therefore be assessed by qualified nurses with sub-optimal knowledge, understanding and skills perpetuating poor practices rather than improving aseptic technique practices (DoH 2003; DoH 2014; DoH 2019).

In the phase one survey it was reported by educators that students' competency in aseptic technique was no longer assessed by mentors in clinical placements in three programmes. Assessment of students' competency in aseptic technique was being undertaken in university instead because of concerns about qualified nurses' poor aseptic technique practice. If there is a lack of confidence in qualified nurses' ability to assess students' competency in aseptic technique,

how can they be trusted to perform aseptic technique safely upon patients. There is an urgent need to address the underlying issue of qualified nurses' poor standard of aseptic technique which places patients at risk rather than compensate by removing their role and responsibilities as assessors. Qualified nurses with poor aseptic technique practices still have the opportunity to influence students' aseptic technique practices as role models whether they are assessors or not.

This study reveals inequality in students' opportunity for competency assessment of aseptic technique in clinical practice across programmes, which might apply to other core skills. Without consistency in the assessment of aseptic technique, there is no guarantee that all students are meeting the same standard of practice. Assessment is crucial in ensuring competency and high standards of patient care (Wu et al. 2015). Lack of opportunity for assessment is not in line with competency based education and may be detrimental to aseptic technique practice. These findings may have implications for the assessment of aseptic technique in other healthcare students.

8.9.2 Frequency of competency assessment

This study found students do not undergo regular assessment of competency in aseptic technique in pre-registration programmes, corroborating what Gould et al.'s (2017) study has suggested. In Gould et al.'s (2017) survey of qualified nurses' understanding of aseptic technique, quality of initial training and lack of regular assessment were identified as possible causes of poor understanding. An isolated university based summative assessment of students' knowledge or performance of aseptic technique in the first year was reported by phase one survey respondents. This study enhances understanding of when aseptic technique is assessed in university across programmes and whether timing of assessment is well placed. Earlier studies suggest first year nursing students may have a summative assessment of competency in some universities (Rush et al. 2014, Gonzalez and Sole 2014).

In Rush et al.'s (2014) study of students' perceptions of OSCAs, students were required to pass a first year summative OSCA for aseptic technique. In Gonzalez and Sole's (2014) pilot study of nursing students' most common breaches in aseptic technique during urinary catheterisation in a simulated environment, a first year competency assessment was insufficient for skill

mastery and retention. There is also a risk, that a one off OSCE assessment of aseptic technique in the first year as reported in this study will not be enough to assure and maintain competency levels. Indeed, findings by Gonsalez and Sole's (2014) found that such an assessment did not maintain competence

More frequent assessment of students' competency in aseptic technique in university may encourage learning. Indeed, it is evident that assessment drives students' learning in undergraduate nursing programmes (Fong-Leung et al. 2008; Helminen et al. 2014). Absence of regular assessment may therefore impair learning.

In the phase one survey, limited opportunity for regular competency assessment in clinical placements was reported. This corroborates research by Stayt and Merriman's (2013). In Stayt and Merriman's (2013) study, only 36% of nurse educators reported competency assessment in clinical practice in each year of their programmes with the majority of programmes assessing students' competency in aseptic technique in years two and three. This, corresponds with NMC guidance (NMC 2010). In the absence of a university based assessment in the first year, students may therefore enter the second year without assessment of aseptic technique. Early assessment enables students' errors or poor practices to be identified and practice developed. If qualified nurses are expected to demonstrate competency in aseptic technique annually (Rowley 2001; Ward 2011) then the same should apply to students. Stayt and Merriman (2013) reported that 63% of nursing students never or only sometimes had the opportunity for mentor assessment of aseptic technique. The findings of this study are in-line with these findings but, from the perspective of nurse educators.

Students have been found to be less likely to fail a practice assessment at later stages in the programme (Hunt et al. 2012). Failure to fail students in clinical practice at the point of registration may result in students entering the workforce lacking competency in aseptic technique, placing themselves, patients and others at risk of infection (DoH 2003; Wilson 2006). The frequency of competency assessment for other core skills should be investigated, as limited opportunity for assessment of other skills e.g. measuring blood pressure was also reported in Stayt and Merriman (2013)'s study.

8.9.3 Methods for assessing competency

In the phase one survey, students were reported to be assessed in clinical placements against a competency statement by mentors. Use of objective assessment methods was rare with three universities reporting use of ANTT assessment or performance criteria. An earlier study by Ward (2011) exploring nursing students' infection prevention education needs in one university indicated that students do not undertake the same annual ANTT assessment as qualified nurses. No previous studies have explored methods of assessing students' competency in aseptic technique across programmes since the introduction of ANTT and NMC Essential Skills Clusters (Rowley 2001; NMC 2010).

Use of performance criteria is preferable to judging practice against a competency statement which might be interpreted differently by mentors. In the absence of the use of performance criteria, assessment of aseptic technique may lack rigour and consistency. Performance criteria ensures that nursing students' knowledge, skills and understanding are measured against set criteria increasing the objectivity of assessment. The subjectivity of competency assessment by mentors in undergraduate programmes is of concern (Hunt et al. 2012; Bennett and McGowan 2014; Helminen et al. 2014; Almalkawi et al. 2018). Systematic reviews identifying inconsistencies in mentors' understanding of competencies, advocate the use of performance criteria (Helminen et al. 2014; Almalkawi et al. 2018). It is highly probable that that there will be difference in the assessment of aseptic technique by mentors without the use of performance criteria, given the variation in practice and the confusion amongst practitioners in this study with regards to what aseptic technique comprises.

Students and qualified nurses should be assessed against the same objective performance criteria for aseptic technique annually (Rowley 2001; Ward 2011). This would help students and practitioners to benchmark their aseptic technique practice against a set standard. Students should strive to reach the same standards of practice expected of qualified nurses. Greater alignment of assessment of aseptic technique in students and qualified nurses may help to close the theory practice gap, bringing what is taught, practised and assessed in university and clinical practice closer together. This will enable educators and practitioners to function as one 'community of practice'. A 'community of practice' approach could be developed for the assessment of other core skills.

The same performance criteria for aseptic technique could be used by other healthcare professionals and students.

8.9.5 Summary

There is inequality in the assessment of aseptic technique for students across undergraduate programmes. There is a need to review the assessment of aseptic technique to ensure that there is congruence between the assessment of aseptic technique in all undergraduate nursing students and that of qualified nurses. Consistency and rigour of assessment of aseptic technique are critical in determining competency levels and raising the standard of practice.

8.10 Research question 5 - How do nursing students', mentors', nurse educators' and infection prevention nurses' knowledge and understanding of aseptic technique compare in two contrasting cases (universities and NHS Trusts)?

Improving qualified nurses' and students' knowledge, understanding and skills in aseptic technique through education and training is a crucial strategy for reducing HCAI and the risk of antimicrobial resistance (DoH 2003; DoH 2014; DoH 2015; O'Neill 2016; WHO 2016a; WHO 2016b; DoH 2019). This study achieved a more in-depth exploration of students' understanding of aseptic technique than previous studies (Davey 1997; Gould and Drey 2013; Mitchell et al. 2014; Carter et al. 2017) exploring multiple perspectives (students, mentors, nurse educators and infection prevention nurses) across two contrasting cases. Case-Study Site 2 reported more innovative educational practice than Case-Study Site 1. The following sections discuss the key findings in relation to knowledge and understanding of aseptic technique revisiting three theoretical propositions.

8.10.1 Understanding of aseptic technique

In the phase two case-study, students and qualified nurses could not differentiate between the aim, principles and steps of the procedure, corroborating Davey' s (1997) findings and the phase one survey findings (see Section 8.7.1). Similarly, in Davey's (1997) study exploring nursing students' understanding of aseptic technique, students demonstrated greater understanding of the procedure and were unable to distinguish between the aim, principles and procedural steps. Education does not appear to have advanced

students' understanding of aseptic technique over time. A different educational approach is therefore required to increase knowledge and understanding of the principles of aseptic technique. The principles of aseptic technique need to be clearly delineated and their importance for safe practice reinforced.

In contrast to the findings of this study, Gould and Drey's (2013) survey of nursing students' experiences of infection prevention in clinical placements suggested that students' knowledge of aseptic technique appeared to be sound. Similarly, Carter et al.'s (2017) survey of infection prevention education reported nearly 99% of nursing students agreed they understood the meaning of aseptic technique. However, neither Gould and Drey's (2013) or Carter et al.'s (2017) study assessed students' knowledge and understanding and therefore the findings may not be a reliable indicator of their knowledge and understanding. In comparison, this study explored students' understanding of aseptic technique in-depth and within the socio-cultural context of learning in university and clinical practice.

The phase two case-study findings substantiate the phase one survey findings of educators' lack of understanding of aseptic technique principles. Educators in the phase two case-study had the same difficulty distinguishing between the principles and steps of the procedure as educators in the phase one survey when identifying what principles were taught to students. These are similar findings to Gould et al.'s (2017a) survey of qualified nurses' understanding of aseptic technique, where 46% described principles but many responses were confined to components of the procedure. This study shows lack of understanding of aseptic technique to be more widespread in educators, students and practitioners including infection prevention specialists. If the principles are not taught correctly, confusion and incomplete understanding will prevail among students and subsequently practitioners. Further exploration of other healthcare professionals' and students' understanding of aseptic technique is warranted, for example in medical students.

Confusion was shown by the terms 'sterile', 'clean' and 'asepsis' being used interchangeably within the same response by students, educators and qualified nurses, irrespective of post from both Case-Study Sites, identical findings to Gould et al.'s (2017a) findings in qualified nurses. This suggests that students and practitioners are not clear about what they are aiming to achieve. The terms 'sterility' and 'cleanliness' are crucial concepts in the understanding and safe

practice of aseptic technique. These findings identify that education is failing to achieve students' understanding of key concepts and the underlying theory and principles of aseptic technique. Education needs to increase understanding of the hierarchy of de-contamination and concepts of 'sterility' and 'cleanliness' in both students and qualified nurses.

Students' and qualified nurses' understanding of aseptic technique in this study, will be compared with Wilson's (2006) definition of aseptic technique. Wilson's (2006) definition although not flawless was accepted for use in this thesis (see Chapter 2) as one of the most accurate definitions. In this study, aseptic technique was variously described as a process, procedure or technique that minimized or prevented infection by students and qualified nurses, corroborating Gould et al.'s (2017a) findings. Similarly, qualified nurses in Gould et al.'s (2017a) study identified aseptic technique as a procedure or method which minimized or prevented contamination or infection. Wilson's (2006) definition does not state it to be anything other than a technique.

Participants identifying the aim of aseptic technique in minimizing the risk of introducing pathogenic micro-organisms or infection, rather than an absolute concept, were closer to Wilson's (2006) definition. Students and qualified nurses recognised the need to prevent contamination or introducing micro-organisms into 'key sites' or 'vulnerable sites', terms used in other definitions (see Chapter 2) which are comparable to 'susceptible sites' used in Wilson's (2006) definition. In this study, students, and qualified nurses, like qualified nurses in Gould et al.'s (2017a) study overlooked the role of aseptic technique in protecting staff and other patients encompassed within Wilson's (2006) definition. The important role of aseptic technique in protecting individuals from infection, may be under estimated. If there is ambiguity about the meaning of aseptic technique, it is improbable that aseptic technique will be taught, role modelled or learnt effectively. Furthermore, if there is uncertainty about what is to be achieved by an aseptic technique, any attempts to improve practices will be in vain. Agreeing an appropriate definition of aseptic technique would help to inform practice, but may be challenging.

Students and qualified nurses across Case-Study Sites commonly identified use of aseptic technique during wound care, corroborating Gould et al.'s (2017a) findings. In this study, students were not directly asked when they would use an aseptic technique but it was established from their interview responses.

In Gould et al.'s study (2017a), nurses most frequently identified wound dressings as a clinical procedure requiring aseptic technique. In Wilson's (2006) definition, only a wound is identified as an example of a susceptible site reinforcing the association between aseptic technique and wound care. The wider application of aseptic technique in any invasive clinical procedure is not acknowledged. Earlier studies found variability in students' understanding of when to use aseptic technique in clinical procedures which may not be routinely undertaken by students, for example in ventilated patients and when manipulating intravascular devices (Ferreira Batista et al. 2013; Mitchell et al. 2014). Lack of recognition by nurses of when to use an aseptic technique, for example in what situation and clinical procedures may cause harm to patients.

8.10.2 Understanding how to apply the principles of aseptic technique

In the phase two case-study, students and qualified nurses across Case-Study Sites lacked a working understanding of how to apply the principles of aseptic technique. Participants spoke of different levels of touch being permissible in different clinical procedures and circumstances. Lack of understanding of how to apply the non-touch principle is detrimental to patient safety as it increases the likelihood of breaching aseptic technique and causing contamination, increasing the risk of infection. Students were frequently observed unconsciously contaminating the susceptible site or sterile equipment during classroom practice, corroborating the findings of earlier studies (Watts et al. 2009; Gonzalez and Sole 2014; Cebeci et al. 2015; Uysal 2016).

In Watts et al.'s (2009) study evaluating the use of videotaped self-assessment in psychomotor skill development, students breached aseptic technique during a wound dressing when preparing the sterile field (54%) and cleaning the wound (34%). Similarly, in Gonzalez and Sole's (2014) study 77% (10/13) of nursing students breached aseptic technique during urinary catheterisation, the majority (54%) when cleaning the urethral meatus. Other studies only report students not following the principles (Uysal 2016) or breaches in aseptic technique (24%) (Cebeci et al. 2015) as the most common error made during injections and intravenous therapy. Earlier studies quantify the number of breaches made by students in clinical procedures differently therefore making comparisons difficult. This study increases understanding of what breaches in aseptic technique are made by students, and why, through observation of teaching and exploring understanding which is important for improving practices.

A difference of opinion about the ability to perform aseptic technique in wound care in the domiciliary setting was evident across Case-Study Sites. These findings endorse the theoretical proposition that students engage in learning and practice of aseptic technique within the boundaries of different communities of practice in university and clinical practice. Qualified nurses and students in Case-Study Site 2 only, stated achieving aseptic technique in wound care difficult or impossible in the domiciliary setting, corroborating Hallett's (2000) findings. In Halletts' (2000) qualitative study of community nurses' perception of the quality of nursing care, nurses were ambivalent about achieving aseptic technique in wound care in the community.

This study has found that teaching contributes to the lack of understanding about how to apply the principles in the domiciliary environment. Difficulty in achieving aseptic technique in the domiciliary environment was reinforced to students verbally and through inappropriate use of trolleys during teaching at Case-Study Site 2. In Case-Study Site 1, although students did not have opportunity to practice aseptic technique in wound care in a simulated domiciliary scenario, there was discussion of how the principles might be applied. University teaching was seen to promote the development of students' knowledge and skills in aseptic technique in the acute setting, rather than any setting or situation. Students need to be prepared to practice aseptic technique in any care setting or situation. Therefore, educators should teach aseptic technique principles in such a way that students are able to apply these principles to any situation or practice setting in which they find themselves. This is the first study to observe university teaching of aseptic technique and explore how education might influence practice, addressing knowledge gaps identified by Hallett (2000).

8.10.3 Standardised practice

In the phase two case-study, qualified nurses, regardless of role in both Case-Study Sites identified the need for standardised teaching and practice of aseptic technique, corroborating Gould et al.'s (2017a) findings. In Gould et al.'s (2017a) study, 99.4% of qualified nurses thought standardising aseptic technique to be important or very important. These findings suggest nurses are aware of variations in practice which persist despite efforts to standardise aseptic technique (Rowley 2001; Aziz 2009; Rowley and Clare 2011; Unsworth 2011). Standardising aseptic technique practice to reduce HCAI, applies to all

healthcare professionals undertaking invasive clinical procedures (Rowley et al. 2010; ASAP 2016).

Students across Case-Study Sites reported to be confused by variations in practice during clinical placements which were not in accordance with university teaching, corroborating the findings of earlier studies (Ward 2010; Cox et al. 2014). The findings of this study support the theoretical proposition that aseptic technique practices learnt in university are only legitimatised and reinforced if similar practices are observed in clinical practice. Similarly, in Ward's (2010) study exploring students' experiences of infection prevention in clinical placements, discrepancies between what was taught in university and observed in clinical practice caused confusion. Likewise, in Cox et al.'s (2014) study exploring infection prevention nurses' perceptions of infection control training in undergraduate programmes, a theory practice gap in aseptic technique was identified. In contrast to the findings of this study, 89% of students in Carter et al.'s (2017) study reported agreement between what was taught about infection prevention in university and observed in clinical practice but these findings may not specifically relate to aseptic technique.

Infection prevention nurses, mentors and nurse educators in this study did not behave as though they belonged to the same community of practice. The findings of this study support the theoretical proposition that students' understanding and practice of aseptic technique is contextualised within the different communities of practice in university and clinical practice. Education and training in aseptic technique in university and clinical practice should be seamless. Knowledge and skills taught in the classroom and practice setting need to be aligned.Until this happens, standardisation of aseptic technique will remain idealistic, with inconsistency in practice, putting patients at risk of infection.

A theory practice gap in nurse education is widely recognised (Hatlevik 2011; Scully 2011; Ahmad et al. 2015). There may be differences between what nursing students are taught about other core skills in university and observe in clinical practice. A theory practice gap in aseptic technique identified in pre-registration nursing programmes in this study might exist in other undergraduate healthcare programmes.

8.10.4 Confidence in competency levels

In the phase two case-study, students were more confident about their competency levels in Case-Study Site 2 where they had more teaching and opportunity to practice than in Case-Study Site 1, corroborating Carter et al.'s (2017) findings. Similarly, students in Carter et al.'s (2017) study who reported receiving the majority of aseptic technique education in simulation or clinical practice reported greater confidence in their ability to insert and maintain invasive devices than students who received more lectures. Students' confidence in their ability to perform aseptic technique during the insertion and maintenance of invasive devices was high in Carter et al.'s study (2017), with only 12% reporting lack of confidence. In this study, students discussed their confidence in competency levels in general, not in one clinical procedure which may not be commonly undertaken by students. The findings support the need for students to gain sufficient practice in the simulated environment. Such practice appears leads to increased student confidence. This study provides greater understanding of students' confidence in their competency levels.

Mentors from both Case-Study Sites were highly confident about their competency despite receiving no updates or re-assessment since training, corroborating the findings of earlier studies (Ward 2012b; Gould et al. 2017a). Similar to the findings of this study, 92% of qualified nurses, in Gould et al.'s (2017a) study were very confident or confident about their practice, although only 21% reported receiving an update and 30% re-assessment since training. Nurses in this study, as in Ward's (2012b) study exploring qualified nurses' attitudes towards the infection prevention nurse, were complacent about aseptic technique. Although in contrast to this study, nurses in Ward's (2012b) study did not see any benefit of educational updates. In the absence of regular assessment of aseptic technique, nurses' competency levels cannot be truly established. Nurses' perceptions of their competency levels will remain unchanged if not informed by assessment, posing a risk to the patients if they are not working within their own level of competency (NMC 2018). This study provides more proof that qualified nurses are not receiving educational updates and assessment in aseptic technique (DoH 2003; Welsh Government 2014; DoH 2015).

Nurse educators and infection prevention nurses in Case-Study Site 1 only were concerned about the rigour of mentor assessment in clinical practice. The

management of HCAI appeared less effective in Case-Study Site 1, which might indicate inferior infection prevention practices. However, the quality of mentor assessment is questionable anywhere given that qualified nurses' knowledge, understanding and practices of aseptic technique are widely regarded as sub-optimal (Bree-Williams and Waterman 1996; Hallett 2000; Aziz 2009; Gould et al. 2017a). No difference was found in educators' and practitioners' understanding of aseptic technique, which was sub-optimal across Case-Study Sites.

The findings of this study suggest that no single group neither practitioners or educators are best placed to teach or assess students' aseptic technique. However, education and training is required to increase knowledge and understanding of aseptic technique. Increasing qualified nurses' opportunity for educational updates and assessment in aseptic technique is imperative in view of the phase one survey findings suggesting high reliance upon mentor assessment of students' competency in clinical placements. The rigour of mentor assessment is a concern for nurse education as a whole (Bennett and McGowan 2014; Almalkawi et al. 2018), suggesting the need to investigate the assessment of other core skills.

8.10.5 Summary

Confusion and lack of understanding of aseptic technique was found to be widespread not only in students and practitioners but educators and infection prevention specialists who might be considered to be experts. These findings may be difficult to accept and even more complex to address given the magnitude of providing education, training and assessment to improve knowledge, understanding and competency in aseptic technique.

8.11 Research Question 6 - What contextual factors influence nursing students' learning and knowledge and skill transfer of aseptic technique in two contrasting cases?

This study explores contextual factors influencing teaching and learning of aseptic technique in university and clinical practice and knowledge and skill transfer in two Case-Study Sites, helping to establish how undergraduate education may be enhanced (DoH 2003; DoH 2014; WHO 2016a; DoH 2019). The two Case-Study Sites chosen for being contrasting cases were found to

have similar educational practices. Five theoretical propositions will be revisited and discussed in relation to the findings about contextual factors influencing students' learning of aseptic technique in subsequent sections.

8.11.1 Teaching steps of the procedure versus principles

The phase two case-study found greater emphasis upon teaching steps of procedures than principles of aseptic technique at both Case-Study Sites, corroborating Theofandis and Fountouki's (2011) findings. Similarly, Theofandis and Fountouki's (2011) audit of teaching male catheterisation in one university revealed nurse educators rigidly taught steps of the procedure from one textbook. In this study, nurse educators considered rote learning steps of aseptic procedures to be important. Rote learning has been reported to encourage students to surface learn, memorising and recalling key facts in isolation without critical appraisal (Mayer 2002; Quinn and Hughes 2013). Rote learning of aseptic technique is at odds with nurse education aspiring to produce competent nurses with critical thinking skills (NMC 2010; Deane and Asselin 2015; NMC 2018).

Students need to acquire knowledge and understanding of aseptic technique for safe practice. Students learning skills in aseptic technique without understanding of underlying principles may increase patients' risk of infection (DoH 2003). Rote learning itself is not incorrect, but teaching steps of aseptic procedures appeared to lead to teaching extraneous detail or minutiae at the expense of principles. Learning aseptic technique in this way does not prepare students to face any eventuality where the environment or equipment may be less than ideal. In this study, students expected to be taught how to perform aseptic technique. A balance needs to be achieved between teaching the principles and steps of aseptic procedures. Teaching the steps of aseptic technique procedures should not overshadow the teaching of the principles. The principles of aseptic technique need to be clearly identified for students. Education needs to do more to reinforce the principles of aseptic technique.

Earlier studies have criticised students for rote learning steps of aseptic procedures to pass practical assessments (Davey 1997; Gonzalez and Sole 2014), and yet this study's findings suggests nurse education appears to promote rote rather than meaningful learning of aseptic technique. Meaningful learning encourages deep learning, critically exploring meaning and concepts

required for problem solving (Mayer 2002; Quinn and Hughes 2013). In the phase one survey, teaching aseptic technique applied to different clinical procedures was dispersed throughout programmes. Rote learning may hamper students' ability to problem solve and transfer learning as reported by Hilgard et al. (1953) for example transferring principles of aseptic technique in different clinical procedures, situations and settings (e.g. the domiciliary environment).

In this study, students and practitioners widely believed any deviations from the way aseptic technique was taught in university was incorrect. There was little recognition that aseptic technique may be practised differently but still follow the same principles. Steps of aseptic procedures may change over time, but underlying principles of aseptic technique remain constant. Movement away from apprenticeship style nurse education into higher education has not stopped idiosyncratic and ritualistic practice.

The concept of 'standardisation' of aseptic technique (Rowley 2001; Rowley and Clare 2011; Loveday et al. 2014), needs to be challenged. In this study, achieving a standardised aseptic technique appeared to promote the idea that all health professionals should follow the same steps. Variations in the practice of aseptic technique are inevitable. The standard of practice should be judged upon whether the principles of aseptic technique have been applied rather than a prescriptive set of steps followed. This requires educators and practitioners to be clear about what the key principles of aseptic technique are first. Education needs to do more to reinforce the principles and acknowledge that different steps may be taken. These findings might apply to learning aseptic technique in other undergraduate healthcare programmes and other core skills in pre-registration programmes.

8.11.2 Role models for aseptic technique

In the phase two case-study, students across Case-Study Sites identified good and poor role models in clinical placements, and could distinguish between good and poor aseptic technique practices corroborating the findings of earlier studies (Ribu et al. 2003; Zisberg et al. 2003; Geller et al. 2010; Ward 2010; Gould and Drey 2013; Westphal et al. 2014; Carter et al. 2017). Similarly, students in Wards' (2010) study described observing good and poor role models, providing examples of poor and good infection prevention practices including aseptic technique. Likewise, 51% of students in Carter et al.'s (2017) survey reported

seeing poor infection prevention practices including aseptic technique. Comparably, students in Geller et al's (2010) study of common infection control hazard and near misses, reported 17.2 % breaks in aseptic technique. This study increases understanding of role models specifically for aseptic technique.

In this study, students identified nurses' breaching aseptic technique (poor hand-hygiene, wearing hand and wrist jewellery, contaminating susceptible sites, sterile gloves and equipment) during different clinical procedures in the community and acute setting, corroborating the findings of earlier studies (Ribu et al. 2003; Ward 2010; Gould and Drey 2013; Westphal et al. 2014). Similarly, in Westphal et al.'s (2014) study of nurses' common shortcuts, students reported observing nurses contaminate the sterile field and equipment during insertion of intravenous cannula and urinary catheters. Identical findings were reported in Ribu et al.'s (2003) observational study of ulcer care, with students identifying community nurses' breaching aseptic technique by poor hand-hygiene and contaminating gloves and sterile field during wound dressings. In agreement with Ribu et al.'s (2003) findings, students in Gould and Drey's (2013) study, were more critical of nurses' aseptic technique practices in the community and long term facilities. Conversely, students in Ward's (2010) study praised community nurses' aseptic technique. Students may therefore encounter good or poor role models for aseptic technique in any care setting. Regular education and training is vital for improving qualified nurses' aseptic technique and being good role models for students. In the absence of education, training and assessment of aseptic technique, qualified nurses' practices will continue to go unchecked, which will be passed onto students the future workforce.

Students responded differently when observing poor aseptic technique in clinical placements, corroborating the findings of previous studies (Ward 2010; Carter et al. 2017). In this study, some students described challenging poor practice and their concerns being disregarded, while others refrained from challenging practice. Similarly, students in Ward's (2010) study were reluctant to challenge poor infection prevention practices due to lack of confidence and fear of repercussions upon relationships and placement reports. In contrast, in Carter et al.'s (2017) study, 70% of students reported being comfortable to speak up about poor infection prevention practices. While students in Carter et al.'s (2017) study appeared to be more confident in challenging poor practice, narrative responses were similar to the findings of this study ranging from speaking up,

but concerns not being taken seriously to not raising concerns for fear of reprisal. Students may be reluctant to challenge mentors' practices as assessors of students' practice they are in a position of power (Bennett and McGowan 2014). Students reluctance to challenge any poor nursing practice for fear of reprisal is well known (Ion et al. 2015; Milligan et al. 2017). Nurses have a professional, moral and ethical responsibility to act and preserve patient safety when quality of care is compromised (Francis 2015; NMC 2015). If students can identify good and poor aseptic technique practice, more could be done to change their response when faced with poor practice by educating and training students in undergraduate programmes to report and escalate concerns as achieved in Geller et al.'s (2010) study.

Despite students being able to differentiate good and poor aseptic technique practices, nurses as role models have a major influence upon students' behaviour. In the phase two case-study, students were portrayed by mentors and students as conforming to mentors' aseptic technique practices to 'fit in', corroborating Ward's (2010) findings. These findings support the theoretical proposition that students may adopt good or poor aseptic technique practices in order to belong and become members of the 'community of practice'. Students need to 'fit in' or 'belong' in clinical placements is widely reported (Levett-Jones and Lathlean 2008; Grobecker 2016; Borott et al. 2016).

The need for students to 'fit in' by following their mentors' aseptic technique practices appears to override the importance of following good practices. One student described continuously altering their practice to match their mentors, whereas other students were adamant they would not change their practice. Similarly, students in Wards' (2010) study described changing and lowering standards of practice to fit in with ward staff. Students' aseptic technique over the course of the programme may therefore be in a constant state of flux. Recent changes to the supervision and assessment of nursing students in clinical practice by separating the roles of supervisor and assessor may help to lessen the effect of students feeling the need 'to fit in' in the future (NMC 2018c). Students may be less fearful that reporting poor practice will have repercussions on their assessment. There would be benefit in conducting a further review of whether students continue to feel compelled to follow their mentors' practice in the future.

Students adapting their practice of other clinical skills in accordance with mentors' practice requires further investigation. This finding gives credence to the theoretical proposition that some students may engage in learning and the practice of aseptic technique within the boundaries of different communities of practice in the clinical setting. This adds further weight to the university and clinical practice needing to work together as one community of practice to improve role models for aseptic technique and bring practice closer together. Variations in the practice of aseptic technique will persist if not addressed.

The findings of this study highlight that students may not be exposed to poor role models only in clinical practice. In the phase two case-study, nurse educators were observed and reported by students contaminating sterile gloves and equipment during demonstrations in university. This finding challenges the theoretical proposition that only poor role modelling occurring in clinical practice influences students' learning of aseptic technique. This is the first study to observe teaching and educators as role models for aseptic technique in university. Nurse educators in the simulated environment are primary role models for students (Cant and Cooper 2010; Berragan 2011; Norman 2012). Role models in university may be more influential upon students' learning than practitioners. Greater exploration of role models in teaching other clinical skills in university is needed (Baldwin et al. 2014).

Poor role models for aseptic technique and incorrect teaching of principles in university as reported in the phase one survey are of major concern for education and practice. Nurse education should be helping students to acquire accurate knowledge and understanding of aseptic technique and instilling good aseptic technique practices. If educators and practitioners are not positive role models, with sound knowledge, skills and understanding of aseptic technique how can students be expected to be competent. Urgent review of undergraduate education in aseptic technique is required to address these issues in order to improve practices and protect patient safety.

8.11.3 Opportunity to learn and transfer skills

In the phase two case-study, students reported lack of opportunity for practice, supervision and feedback upon aseptic technique in university conflicting with the phase one survey findings. Similar findings were reported in Haraldseid et al.'s (2015) study of nursing students' perceptions of learning in the clinical skills

laboratory with students identifying the need for greater practice and feedback on performance. In the phase one survey 94% of nurse educators reported that all students have opportunity to practice in university. These findings show that educators and students had different perceptions of education and training in aseptic technique. If students perceive a lack of opportunity to practice and gain supervision and feedback upon their aseptic technique, this suggests that education is not adequate in meeting their needs. No prior study has explored students' opportunity to learn aseptic technique in university.

The findings of this study oppose the theoretical proposition that learning in the community of practice in university assists students to develop knowledge and skills in aseptic technique and provide meaning through 'learning by doing'. In this study, students described prior experience, time, physical environment, lack of equipment and group size restricting opportunity to practice in university, which was corroborated by observations at both Case-Study Sites. Similarly, students in Haraldseid et al.'s (2015) study, identified time constraints, lack of equipment and the physical environment as influencing clinical skills learning.

In Case-Study Site 1 only, students lacked opportunity to practice aseptic technique in wound care in the simulated environment prior to practice on patients their first clinical placement. This study exposes differences across programmes in student's opportunity to practice aseptic technique in wound care. Students should have the same opportunity to practice aseptic technique in university which can be controlled unlike that of the clinical practice setting. There is a risk that mentors may assume that all students have had opportunity to practice aseptic technique in wound care in a safe environment when they have not. Student's first opportunity to practice an aseptic technique in wound care may only be upon patients, placing patients at risk. According to Hope et al. (2011) students practising on patients in clinical practice without opportunity to practise in the safe, low risk and supervised simulated environment first may be considered unethical. These findings might apply to teaching of aseptic technique in other undergraduate healthcare programmes.

Students from both Case-Study Sites identified timing and authenticity of learning aseptic technique in university influenced skill transfer from university to clinical practice. These findings support the theoretical proposition that knowledge and skill transfer are aided if learning is authentic and replicates clinical practice and situations where aseptic technique is practiced. Students

identified time from learning aseptic technique in university to being able to practice in clinical placements too long and the need for more regular updates. Students perceived simulation did not fully prepare them for undertaking aseptic technique in the uncontrolled environment of clinical practice and different situations. These are similar findings to Hope et al.'s (2011) study exploring students' perceptions of learning in the clinical skills laboratory, where students recognised there were fewer extraneous distractions in the simulated environment. While it is recognised there are limitations to practising aseptic technique in the simulated environment, this is considered to be better than students having no opportunity to practice aseptic technique and so the inability to build confidence.

Students in the phase two case-study identified insufficient opportunity for practice, supervision and feedback upon aseptic technique in clinical placements, corroborating Stayt and Merriman's (2013) findings. Similarly, in Stayt and Merriman's (2013) study, 44% of students reported never or sometimes having opportunity to practise aseptic technique, with 74% never practising unsupervised. In this study, time, workload and busy clinical environments were described as being responsible for limiting opportunity for practice, supervision and feedback upon aseptic technique in clinical placements. Stayt and Merriman's (2013) study suggests students may have limited opportunity for practice, supervision and feedback of other core skills in clinical placements which needs investigating.

The study findings show that students are dissatisfied with their opportunity to learn aseptic technique in university and clinical placements. These findings together with the phase one survey findings that educators want greater time for teaching, call for education and training in aseptic technique to be improved. Education should create not restrict opportunity for learning. Lack of opportunity for students to gain adequate practice, supervision and feedback upon aseptic technique in university and clinical placements, threatens the development of knowledge, understanding and competency and patient safety by increasing infection risk (DoH 2003). There is a risk that students may enter the professional register and workforce with inferior knowledge, understanding and skills in aseptic technique.

8.11.4 Communities of practice for aseptic technique

The phase two case-study findings identified lack of joint working between universities and NHS trusts in education and training of aseptic technique, corroborating Ward's (2011) findings. Similarly, in Ward's (2011) study, students and mentors recognised the need for joint responsibility for infection prevention education between university and practice placements. The findings of this study, and Ward's (2011) study, suggest greater collaboration and sharing of infection prevention knowledge including aseptic technique between academics and clinicians (DoH 2014; WHO 2016a) is yet to be achieved. There are clear benefits to achieving this, which are highlighted by the current limitations of education and training in aseptic technique identified from this study.

Infection prevention nurses from both Case-Study Sites did not teach aseptic technique in pre-registration programmes. Practitioners including infection prevention nurses were unaware of what students were taught about aseptic technique in university, corroborating Cox et al.'s (2014) findings. Similarly, in Cox et al.'s (2014) study, infection prevention nurses described lack of input and awareness of what was taught about infection prevention in university. Students are therefore not benefiting from the expertise of infection prevention specialists, who are at the forefront of preventing infection. In this study, university and NHS trusts functioned as separate communities of practice rather that one 'community of practice' for aseptic technique. This finding supports the theoretical proposition that students' understanding and practice of aseptic technique is contextualised within the different communities of practice in university and clinical practice. If practitioners are unaware of what is taught about aseptic technique in university, it questions how they can effectively support and reinforce what students have learnt in clinical placements. The division between the university and clinical practice setting is unhelpful in an area of practice that it so critical to patient safety. Greater transparency and sharing of information between universities and NHS trusts is required to improve aseptic technique practice. Practitioners may also lack awareness of what is taught about other core skills in university.

The phase two case-study found no clear roles and responsibilities for education, training and audit of aseptic technique in NHS Trusts. Infection prevention nurses across Case-Study Sites had different opinions about responsibility for education and training in aseptic technique. National and

international policy are unequivocal about infection prevention teams being responsible for infection prevention education and training, a core component of all infection prevention programmes (DOH 2014; WHO 2016a). The findings of this study confirm education, training and audit of aseptic technique have not received the same attention as hand hygiene. Many infection prevention nurses described aseptic technique as difficult to review, a hidden practice occurring behind closed doors or curtains. Also, aseptic technique may be seen as part of different clinical procedures (Loveday et al. 2014; Infection Prevention Society 2017), rather than a discrete practice. This study increases understanding of why education, training and audit of aseptic technique may have been overlooked.

Education and training in aseptic technique should be seen as a continuum of learning from pre-registration programmes throughout nurses' careers. Qualified nurses need regular educational updates and assessment in aseptic technique to be safe practitioners, credible teachers and effective role models (DoH 2003; Loveday et al. 2014; Welsh Government 2014; DoH 2015). In the absence of regular educational updates and assessment in aseptic technique, confusion and poor aseptic technique practice will persist.

8.11.5 Summary

Education and training in aseptic technique is far from ideal. Teaching the steps of aseptic procedures taking precedence over teaching the underlying principles may account for why understanding of aseptic technique is poor. Poor role models for aseptic technique influence students differently. Education and training has the potential to transform how students respond in the presence of poor role models. Limited opportunity for students to practice aseptic technique and gain supervision and feedback may impair the development of competency and allow poor practices to go uncorrected. Inconsistency between what is taught about aseptic technique in university and seen to be practised in clinical placements undermines practice leaving students confused about what practices they should aspire to achieve.

8.12 Implications of the findings for nurse education

The study has found undergraduate education and training in aseptic technique is poor. There is much inaccuracy and disparity in terms of what, when and how aseptic technique is taught and assessed. An immediate review of the teaching and assessment of aseptic technique in undergraduate nursing programmes is required. National guidelines for education and training in aseptic technique are also required. It is critical that education and training in aseptic technique is improved to raise the standard of practice and prevent HCAI and the risk of antimicrobial resistance.

The findings of this study have wider implications for nurse education. The NMC competencies (NMC 2010) and standards of proficiencies for new nurses (NMC 2018a) for aseptic technique are not in line with societal and clinical need for excellent infection prevention practices to reduce the risk of antimicrobial resistance. There is a need to review and revise the NMC proficiencies for aseptic technique in Annex B of the standards of proficiencies for nursing procedures (NMC 2018a) and review NMC proficiencies for other core skills.

Poor knowledge and understanding of aseptic technique by educators who teach aseptic technique, and infection prevention specialists and are considered to be experts, is of major concern. If the teaching and assessment of aseptic technique is sub-optimal, this might true of other aspects of the curriculum. It also brings into question the credibility of educators and quality of education in spite of standards for pre-registration nursing programmes (NMC 2018b). There is a need to review the teaching of other core skills in undergraduate nursing programmes.

Educators and practitioners were unable to state and apply principles of aseptic technique. A lack of understanding of the general concept of a ‘principle’ was also shown. Principles of nursing practice are important in the delivery of safe and effective nursing care (RCN 2017). Education needs to help clarify understanding of the concept of a principle as well as principles of aseptic technique. This study highlights the risk of a spiral curriculum, if not achieved, disintegrating into the delivery of piecemeal, repetitive, and fragmented information throughout programmes.

8.13 Limitations of the study

This study has several limitations. A single educator from each university responded to the phase one survey; the person best placed to provide information may not have been found. Social desirability was a risk, with educators and students wanting to uphold the reputation of their university. Infection prevention nurses and mentors may have been reluctant to expose sub-optimal practice in their organisation. Limited observation of teaching was undertaken in Case-Study Site 2. Observation was not undertaken in clinical practice to establish the standard of aseptic technique practice.

There was no follow-up of non-responding universities or participants that declined to participate in the study. The motivation of universities and participants that did or did not respond is unknown, making it difficult to establish how typical respondents were. Participants may have had a greater interest or issue with aseptic technique practice than those who did not respond. Only adult nursing students were recruited to the study. Students from other fields of nursing, practice facilitators and educators might have provided different perspectives upon education and training in aseptic technique.

The Case-Study Sites were typical of universities providing NMC approved pre-registration programmes, but other extraneous variables may have been overlooked. No data were collected upon staffing and resources in university to determine how this might have influenced education and training in aseptic technique. The number of Case-Study Sites used was constrained by geographical distance, time and costs. More Case-Study Sites might have yielded greater insight into students' learning of aseptic technique. At the time of the study, ANTT was being implemented in NHS trusts and the pre-registration programme in Case-Study Site 1 and was not well established.

8.14 Recommendations for education

Some key recommendations will be made for education first which will be followed by specific recommendations for education for nursing students, nurse educators, qualified nurses/mentors and infection prevention nurses. Key recommendations are to;

- Review the teaching and assessment of aseptic technique in pre-registration nursing programmes

- Develop national guidelines for the education and training of aseptic technique
- Revise the NMC proficiencies for aseptic technique (NMC 2018a)

8.14.1 Recommendations for nursing students

For nursing students to have:

- Greater time and opportunity to practice aseptic technique in different clinical procedures and situations and other core skills through simulation prior to clinical placements.

- Greater opportunity to revisit learning of aseptic technique and other core skills regularly throughout their programme, and so building upon their knowledge and skills, in line with a spiral curriculum approach.

- Greater opportunity for supervision and 360-degree feedback upon their performance of aseptic technique and other core skills within the simulated environment.

- An annual practical assessment of aseptic technique. Performance assessment criteria should be developed and used to assess both students' and qualified nurses' competence in aseptic technique.

8.14.2 Recommendations for nurse educators

For nurse educators to have:

- An annual education and training update in aseptic technique including practical assessment and demonstrate competency.

- Greater understanding of aseptic technique and to be able to clearly articulate the principles of aseptic technique to students and demonstrate how these might be applied to practice.

- Greater accuracy in teaching aseptic technique and other core skills and act as positive role models in the simulated environment.

8.14.3 Recommendations for qualified nurses

For qualified nurses as mentors to have/to:

- An annual education and training update in aseptic technique including assessment of the application of aseptic technique that is relevant to the practitioners' area of clinical practice.

- Education and training updates which refresh knowledge and understanding of the hierarchy of de-contamination and fundamental principles of asepsis.

- Increased awareness of the importance of providing students with the opportunity to practice aseptic technique and other core skills under supervision and receive feedback in clinical placements where appropriate.

- Act as positive role models for aseptic technique and other core skills in clinical practice.

8.14.4 Recommendations for infection prevention nurses

For infection prevention nurses to:

- Receive an annual education and training update in aseptic technique in aseptic technique including practical assessment.

- Collaborate closely with universities in the development of education and training in aseptic technique, in order to function as one 'community of practice' for aseptic technique and other core skills. Educators and infection prevention teams should agree upon what is taught and assessed about aseptic technique in pre-registration programmes and in educational updates for qualified nurses.

- Work together with educators at national and local level to develop a national and local policy for aseptic technique. Local policy should provide clear guidance upon the standard of practice expected and roles and responsibilities for education, training and audit of aseptic technique.

- Work with nursing and allied health professional regulatory bodies to ensure that competencies are dynamic and responsive to national and international infection prevention policy.

8.15 Recommendations for research

- To investigate education and training and understanding of aseptic technique in other healthcare professional students e.g. medical students.

- To explore a comparative case-study site where ANTT is well established in the pre-registration programme and NHS Trusts.

- To develop a working definition of aseptic technique through expert opinion involving key stake holders such as educators and infection prevention specialists. A working definition will help to develop a common understanding of aseptic technique to inform practice, education and policy.

- To explore the effectiveness of different approaches to teaching and assessment of aseptic technique. This might include exploring innovative technologies for providing immediate feedback upon students' performance of aseptic technique.

- To investigate the effectiveness of meaningful learning of principles versus rote learning steps of procedures in developing students' competency in aseptic technique and other clinical skills.

- To explore whether a spiral curriculum approach to learning aseptic technique and other clinical skills is achieved.

8.16 Conclusion

This study found nursing students' education and training in aseptic technique requires improvement if the risk of HCAI and antimicrobial resistance is to be reduced. Current infection prevention policy is not sufficiently informing the education or practice of aseptic technique. This study makes a key contribution to nurse education by exposing a lack of accuracy in teaching aseptic technique in pre-registration nursing programmes. Teaching of aseptic technique can be improved by addressing not only the lack of accuracy but also by providing students with greater opportunity to learn and practice aseptic technique in programmes. Enhancing the quality and standard of teaching is crucial for improving infection prevention practices and protecting patient safety.

The theoretical propositions of the case-study derived from the Communities of Practice theory and Social Learning theory were highly significant. Universities and clinical practice operated as separate communities of practice for aseptic technique. A gulf existed between what was learnt in university about aseptic technique and observed by students in clinical practice. As a result of the dissonance between what is taught about aseptic technique in university and seen in clinical practice, students found it difficult to transfer their knowledge and skills from university to clinical practice. Poor role models for aseptic technique were reported in the university and clinical practice setting. However, role models in clinical practice appeared to be more influential upon students' practice of aseptic technique. Students often succumbed to adopting mentors' practice of aseptic technique in order to belong and become members of the community of practice in clinical placements. The findings of this study have wider implications for undergraduate nurse and healthcare professional education with regards to education and training in aseptic technique and other core skills.

This thesis has highlighted the importance of enquiry as educators into what we teach, how and why. Reflecting on teaching is just as important as reflecting on clinical practice. Through observation and reflection on teaching, a theory practice gap in aseptic technique was identified and became the catalyst for this study.

This study has provided new insights into education and training of aseptic technique in pre-registration nursing programmes. Further research is needed in this area. This study is just the foundation of a body of work to investigate how education, training and assessment of aseptic technique in undergraduate nursing programmes might be improved in the future.

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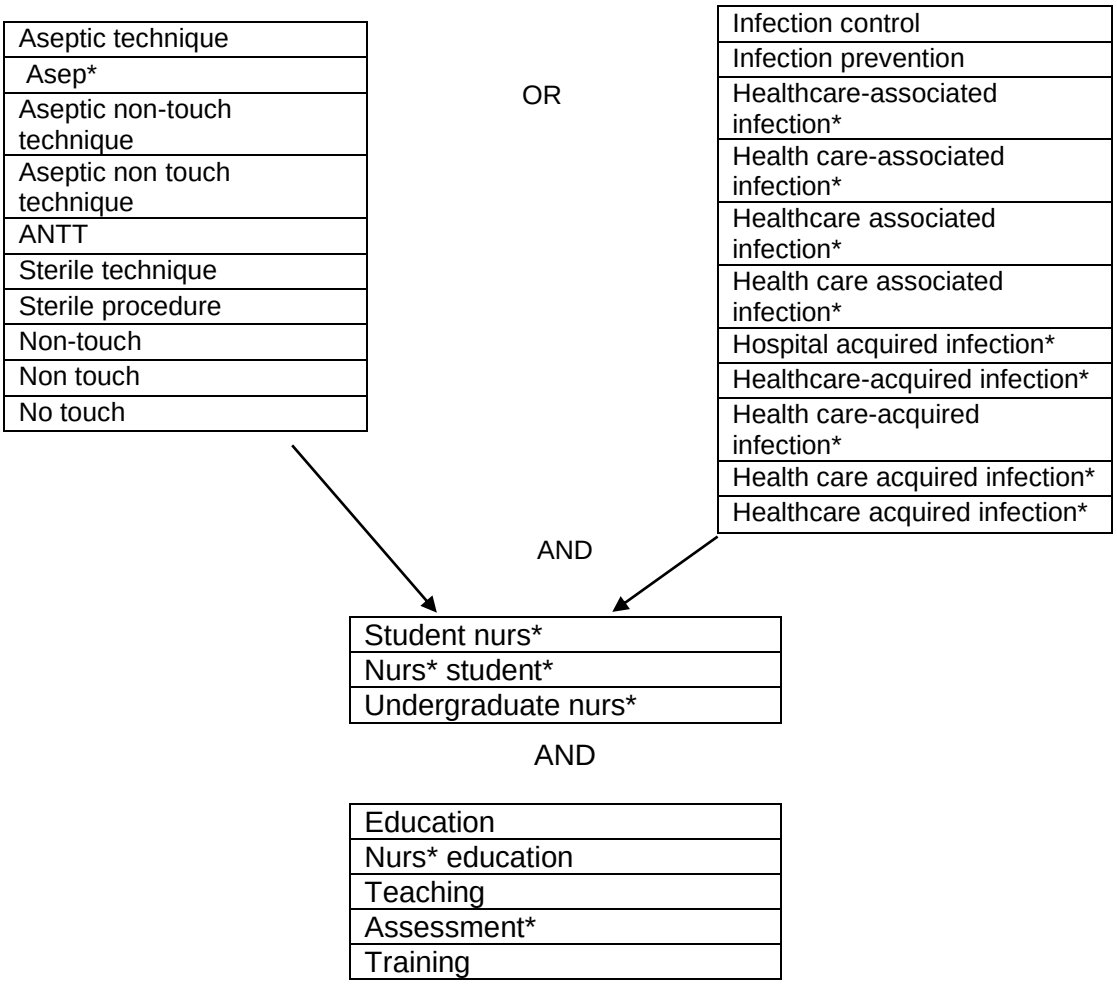
APPENDIX 1–Literature review methods and results

Figure 1 showing the literature search keywords used



*Truncation symbol to search for different forms of words

Table 1- Database results

Database	Results
CINAHL	305
Medline	90
British Nursing Index (BNI)	258
Scopus	168
Web of Science	10
Embase	134
Cochrane library	7
ERIC	1
JBI	15
HMIC	10
Proquest Dissertations & Theses	8
SIGLE	0
Grey literature report	0
TOTAL	**1,006**

Screening Tool: Aseptic Literature Review (Version 2:31/1/14)

Reference: _____
Country_____Reviewer_____

	Yes	No	
Aseptic technique (AT)	☐	☐	exclude
Infection control including AT	☐	☐	exclude
Nursing students	☐	☐	exclude
Learning /practice of AT	☐	☐	↘
			Exclude (if both no)
Assessment of AT	☐	☐	↗

Setting

University/classroom: ☐

Clinical setting: ☐

Research ☐ ☐ exclude

Review article ☐

If included then

Quantitative ☐ Specify……

Qualitative ☐ Specify……

Sample/participants:

Data collection methods:

Key findings:

Conclusions:

Table 2 - Included Quantitative studies

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
Effectiveness of different teaching/learning methods **O'Neill (2001)** *UK* To investigate the effect of stimulated recall upon skill acquisition & competence in a simulated environment	Pre-test post-test control group design	Convenience sample n=43 1st year undergraduate nursing students **E** (n=19) **C** (n=24)	Randomised to grps; **Phase 1** **E & C** tracheostomy dressing on mannequin videoed faculty & self-assessment of asepsis maintenance **E** stimulated recall only **Phase 2**-1 month later repeat as per phase 1	-11 item AT score sheet (0-10 scale) -Qs: asepsis maintained? to monitor phase 2 extra activities -1:1 interviews & critical analysis of video performance	Self-assessment of asepsis maintenance pre-post **E** -79%-95% **C-** 83%-79% Significant improvement in assessor's evaluation of asepsis maintenance pre 2(11%) - post 17 (95%) in **E** $X^{2=}$23.75 p=0.00001 not in **C** 7(29%) to13 (54%) X^2=2.14 p=0.14 Improvements in asepsis maintenance agreement between assessor & student in **E**10%-89% & **C** 29%-54%. No significant association between grp & phase for correct evaluation of asepsis (X^2=0.5 p=0.4)
Jeffries et al. (2002) *USA* To compare the effectiveness of two instructional methodologies in teaching skills in the skills laboratory	Pre & post test design	Convenience sample of n=120 baccalaureate students (2nd n=70 & 3rd year n=50)	**Wk 6 pre-test** **Traditional- 3rd yrs**-Reading, lectures, demonstrations, videotapes & lab practice **Interactive- 2nd yrs** -Reading, self-study module prior to lab practice (interactive stations) **Wk 7 post-test** Assessment of sterile dressing performance	-Questionnaire (satisfaction, self-efficacy & self-reliance in learning) -20 item knowledge test -Laboratory skills competency checklist	-No significant differences in knowledge Pre-test **IG** 74.8 & **TG** 75.0 & post-test scores **IG** 87.7 & **TG** 87.3 -All students passed surgical asepsis skills on 1st attempt -Significant differences in satisfaction (p<0.01) not self-efficacy or self-reliance
Melby et al. (2007) *Ireland* To investigate the importance of lecturer demonstration on the performance of a psychomotor skill	RCT	n=161st year students (1 of each of 4 learning styles from 4 sites).	Randomised 2 students from each learning style into grps; To learn how to give an IM injection; **C**-learning materials (2x clinical books & practical equipment) & 30 mins demonstration **E** -30min access to above learning materials when **C** having demo	- Honey & Mumford Learning Styles questionnaire -Analysis of videotaped performance of 1 student in each group - Self-administered perceptions questionnaire (4 items)	-63% (5/8) **E** thought it better with & 88% (7/8) **C** worse without a demonstration -88% (7/8) of **E** &100% (8/8) of **C** thought they could not learn a skill without a demonstration -Student videoed in **E** did not adhere to aseptic principles in maintaining asepsis of equipment and during technique preparation

Table 2 - Included Quantitative studies (continued)

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
Wright et al. (2008) *UK* To evaluate the effect of PETTLEP based imagery training on skill performance	Pre & post-test design	n=56 pre-registration students	Assigned to 2 groups; 1) **E-** Practice session of OSCE & PETTLEP imagery both skills 3x week for 4 weeks 2) **C**- Usual preparation (reading over procedure & memory recall)	-8 item MIQ-R prior to study -Interviews E-pre-test (experience of skills) & C- post-test (check for conscious use of imagery) -OSCE AT assessment - dressing on a simulated patient (n =18) & BP skills (n=38)	No significant difference between **C (**mean 88.56) and **E** (mean 85.2) for AT OSCE scores *(F1,16=0.17 p=0.69)*. **E** performed statistically significantly higher (mean OSCE score 93.63) on BP OSCE than **C** (mean OSCE score 82.24) *(F1(1,36=4.62 p=0.038)*
Watts et al. (2009) *Canada* To evaluate the use of self-assessment using videotaping in psychomotor skill development	Evaluative	n=86 1st year nursing students	Learning activities (reading, lectures, video & instructor demo AT case-study & practice in & outside lab using checklist) -20 mins videotaped sterile dressing change on manikin in lab -40/86 videotapes randomly selected for analysis	-Faculty performance checklist (19 items) -Student self-assessment checklist	-No. of breaks in AT identified by faculty 2 to 3 times higher than students (Students 0-7 & faculty 0-12) -Most breaks in AT identified by faculty were related to setting up the sterile field 54% (45/83) and cleaning the wound 34% (28/83)
Theofanidis &Fountouki (2011) *Greece* To audit & improve undergraduate nurse training in male bladder catheterisation	Audit	n=4 nurse educators	Teaching male catheterisation using manikins in pairs	-Audit of practical classes over 2 sessions (2hrs) for 2 wks -Diary recorded -Demonstration compared to International best practice guideline -Analysis of handouts & textbook	-Scores 4/4 (no deviations from standard) for; 1) use of sterile gloves 2) per-uretheral cleansing 3) handling of catheter 4) layout of materials -1 aseptic procedure followed by all staff with no discussion of other ways which are equally sterile but not in textbook

Table 2 - Included Quantitative studies (continued)

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
Walsh et al. (2011) *Canada* To compare the effectiveness of peer, expert & computer assisted learning on the acquisition, retention & transfer of skills in the simulated setting.	Randomised Trial (pre & post- test design)	n=25 nursing & n=35 medical students **EAL** n=19 **PAL** n=19 **CA**L n=20	Students not performed urinary catheterisation randomised into 3 groups -10 min video -1 **EAL**, **PA**L or **CAL** session - Urinary catheterisation on female simulator x3 videoed	-Baseline questionnaire - female urinary catheterisation performance pre, post & 1 wk retention test on simulator -Integrated Procedural performance instrument format transfer test (on female infant simulator) -Catheterization checklist -GRS	-Breaks in AT significantly reduced, checklist & GRS scores increased from pre to post-test (p=<0.05) no differences between grps (p>0.05) -No significant difference between post & retention test scores -On transfer test **EAL** grp had significantly fewer breaks in AT, higher checklist & GRS scores than **PAL** grp (p=<0.05) - No significant differences between **CAL, EAL or PAL** (p>0.05)
Zhang (2015) *China* To explore the effect of standardized teaching ward rounds in clinical nursing on preventing hospital-acquired infection	Quasi-experimental	n=240 nursing students **C** (n=120) **E** (n=120)	**C** Traditional ward rounds, Fortnightly nurse led ward rounds **E** Standardised teaching ward round every 2 wks using different formats; teaching & discussion, field experience & case discussion; disinfection, sterilization & AT training	-Self- administered patient satisfaction & students' knowledge of hospital acquired infection questionnaire -Ability to apply nursing procedures & pass rate of comprehensive skill tests	-Significantly higher scores for AT in skills tests in **E** (97.5%) than **C (**91.7%) (*p=0.046*) -Significant higher knowledge of aseptic operation in **E** (98.3%) for AT than **C** (90.0%) (*p=0.006*)
Uysal (2016) *Turkey* To determine nursing students common mistakes in NSLE & evaluate the effect of scenario-based NSL practices on reducing mistakes in exams & scores	Retrospective analysis Quasi-experimental	n=605 NSLE 2nd yr exam papers (2005-2012)	Scenario based skills training	-Exam control lists for each skill in the NSLE between 2007-2012 -Scores on NLSE control lists between 2005-2006 examined & analysed	-Most common mistake- not following principles of asepsis in 2nd yr students for IM injection 2007; 10/47 (21.3%),2008;7/37 (18.9%) & 2009;33/73 (45.3%) & SC injection 2009; 28/77 (36.3%) & IV access 2007; 10/41(24.4%), 2008;8/34 (23.5%) & 2009; 15/35 (42.8%) in first year of scenario based training -Significant higher mean NLSE scores for scenario than non-scenario based studies (p=0.000) except 2009-10

Table 2 - Included Quantitative studies (continued)

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
AT Knowledge, understanding & skills **Gonzalez & Sole** (2014) *USA* To assess student competence on skill attainment in urinary catheter insertion & identify the most common AT breaches	Pilot study- Quantitative descriptive	Convenience sample of n=13 Baccalaureate nursing students	-15mins to perform female catheter insertion on manikin & videotaped &de-briefed	- Perceived level of confidence questionnaire scale (1-5) - independent analysis using standardized competency checklist by 2x faculty members	-77% (10/13) breached AT in at least one category -Most common breaches of AT - made by 7 students (54%) when cleaning the urethral meatus -Mean self-rating of confidence 3.6
Rush et al. (2014) *UK* To establish students' experiences with the first year OSCA & feedback	Evaluation	n=180 first year students	Completion of the end of first year OSCA	Online survey- 18 Likert style questions OSCA assessment results	161/180 89.4% Passed AT OSCA at first attempt 4/180 2.2% at second attempt 15- No answer
Ferreira Batista et al. (2013) *Brazil* To investigate nursing students understanding of prevention of infection in ventilated patients in Intensive care units	Exploratory survey	Convenience sample of n=30 Bachelor of Nursing students		Questionnaire	-11/118 (9%) responses to using sterile gloves or not to perform endoctracheal suction to prevent infection -(10) 23% cited the use of AT to prevent infections
Mitchell et al. (2014) *Australia* To determine graduating nursing students' knowledge of and intentions towards IPC practices	Cross-sectional	n=349 final year nursing students volunteered from six universities		-Online survey- 31 questions (n=27 dichotomous n=4 Likert scale)	-60% of students strongly agreed that AT should be used when manipulating intravascular devices.

Table 2 - Included Quantitative studies (continued)

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
Cebeci et al (2015) *Turkey* To determine the number & type of medication administration errors made by nursing students & to explore the rate of reportings, emotions after & cause of errors	Cross-sectional	n=324 purposive sample of nursing students from 2 Schools of nursing		Questionnaire 1) demographics 2) 3 open ended questions -medication & reporting errors 3) clinical errors, reasons, contributing factors & emotional reaction	-Total n=420 of errors - no. of errors 96 (23.8%) deviations from AT -Most common cause of errors were performance deficits 141 (43.4%) & knowledge deficits 133 (41.1%) - Most common emotional reaction 45 (28.8%)
Carter et al (2017) *USA* To examine the relationship between hours of IPC education & students' IPC knowledge, attitudes & practices in hand hygiene, personal protective equipment, isolation precautions and aseptic technique	Cross-sectional survey	n=3678/52,063 nursing students NSNA members		On-line survey 45 Likert-scale questions on 1) experiences of IPC curriculum in 5 areas including AT	-Almost 99% agreed they understood the meaning of AT & that aseptic placement & maintenance of invasive devices prevents infections. -12% not confident in using AT when inserting & maintain invasive devices ---16% had difficulty in AT when busy **Students' experiences of learning AT in clinical placements** -51% witnessed poor IPC practice including AT. Of these 70% were comfortable to speak up. Free text comments (n=812) -4 themes 1) history of speaking up but concerns not taken seriously 2) willingness to speak up 3) difficulty speaking up 4) fear of retaliation **Perceptions of IPC/AT training** - 34% reported receiving 4-8 hrs of AT education - AT education received through simulation (63%) lecture (21%) in clinical setting (15%) -Significant association between hrs of AT education & respondents agreeing difficulty with IPC practices when busy ($p<0.0001$) -Those who received AT training in simulation or clinical practice were more confident in their ability to insert & maintain invasive devices than those who reported lectures ($p=0.003$). -89% reported agreement between what was taught in schools & observed in clinical practice

Table 2 - Included Quantitative studies (continued)

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
Students' experiences of learning AT in clinical placements **Zisberg et al (2003)** *Israel* To test the hypothesis 'that the presence of nursing students will improve the quality of care provided by nurses'	Experimental within subject design	Non-probability sample of n=67 registered nurses working in 15 general ward	Nurses' care during a shift under 2 conditions; **E**-with students **C**-without students	-Quality of nursing care measure surgical (130 items) medical (110 items) 1/7 indices 'keeping with aseptic rules' -Observation by 1 clinical instructor per ward -Perceived workload & 2x manipulation check questions (awareness /affect of other people's presence)	-Keeping with aseptic rules mean index score 0.85 (0.18) with students & 0.72 (0.15) without students Quality of care significantly higher with than without students ($p<0.001$), no significant differences in workload.
Ribu et al (2003) *Norway* To obtain knowledge about leg and foot ulcer care by community nurses	Descriptive observational study	Non-probability sample of n=30 final year nursing students, n=31 RNs & n=32 patients with leg & foot ulcers		-Semi-structured observational instrument (15 categories) -Observation by student pairs (15) in each patient's homes over 7 weeks -Photographs of ulcers	**Medical asepsis** 21 (60%) washed their hands before and after ulcer treatment (n=1 did not wash hands at all, n=6 wore gloves instead of handwashing, n=1 took on & off same gloves). Inappropriate dress (n=2 rings, n=1 watches & n=1 loose hair) & n=1 placed dirty linen under leg.
Geller et al (2010) *USA* To describe the frequency and types of infection control hazards and near misses reported by nursing students over 3 years	Retrospective data analysis	Non-probability sample of n=500 nursing students (yr1 n=158, yr 2 n=178 & yr 3 n=164)		For 5 clinical rotations students completed 2 entries per week in a structured electronic hazard & near miss database over 3 years.	-886/3492 (25.4%) comments related to IPC -17.2% breaks in AT (3rd most common category) -Yr1-12.1%, Yr2-20.4%, Yr 3 -16% AT hazards/ near misses reported
Stayt & Merriman (2013) *UK* To evaluate pre-registration student nurses' perceptions of clinical skill development in clinical placements	Cross-sectional survey	Non-probability sample of n=421 pre-registration nursing students from all fields		On-line questionnaire (16 Likert style & open ended comments)	-73.7% students never practise ANTT unsupervised. Opportunity to practice ANTT-55.5% always/usually & 44.4% never/sometimes -ANTT Assessment by mentor- 63.1% never/sometimes & 36.9% usually/always

Table 2 - Included Quantitative studies (continued)

Study & location Aim	Study design	Sample	Intervention	Data collection	Key findings
Gould & Drey (2013) *UK* To explore student nurses' experiences of infection prevention and control (IPC) during clinical placements.	Descriptive survey	Non-probability sample of n=488 pre-registration nursing students from 4 UK countries		Online questionnaire (19 Likert questions & 1 open ended question)	-All students witnessed lack of IPC compliance -Qualified nurses & doctors AT heavily criticised. -Poor AT compliance in community settings & long stay elderly facilities. -Poor AT practices in doctors during intravenous cannula insertion -n=6 students had good knowledge of principles.

KEY AT- aseptic technique; ANTT- Aseptic Technique Non-Touch Technique; Control-C Computer assisted learning-CAL; Expert assisted learning-EAL; E-Experimental; IPC-Infection Prevention Control; IG- Interactive Group; IM; Intra-Muscular IV;Intra Venous; Movement Imagery Questionnaire-Revised (MIQ-R) NSNA-National Students Association NSLE-nursing skills laboratory examination ; NSL- nursing skills laboratory Objective Structured Clinical Assessment –OSCA; Peer assisted learning (PAL); Physical , Environment, Task, Timing, Learning, Emotion & Perspective (PETTLEP) RN-Registered Nurse;SC-Subcutaneous; TG-Traditional group

Table 3-Included Qualitative studies

Study & location Aim	Study design	Sample	Data collection	Key findings
Effectiveness of different teaching methods/approaches **Mackey et al (2014)** *Singapore* To determine the value of being a standardised patient on student learning outcomes	Qualitative	Purposive sample n=15 3rd year and final year Bachelor of Science nursing students	2 x focus groups 1 n=7 students 1 n=8 students	**1 /4 main themes**-Using observation skills **Subtheme 2** Comparisons- between observed students performance of AT & their own skill level **Subtheme 3** Criticisms students observed poor AT in wound care & concerned for pt safety
AT Knowledge, understanding & skills **Davey (1997)** *Australia* To explore nursing students' understanding of the concept of asepsis within the clinical skills laboratory	Phenomenographic study	Convenience sample of n=18 undergraduate 2nd year nursing students	Written exercise & in-depth interviews	No student had a complete understanding of AT n=2 students had principled understanding of AT n=9 had a procedural understanding n=7 had a global understanding (preventing spread of micro-organisms)
Cox et al (2014) *Australia* To explore Infection control professionals' perceptions of microbiology & infection control training in undergraduate nursing curricula & perceived transferability of knowledge	Qualitative	Purposive sample n=8 Infection control nurse practitioners	Semi-structured interviews-open ended questions	**4 main themes;** **1) Theory v practice** - AT Theory practice gap i.e. know how of donning gloves & gown, IV fluids- poor AT **2) Importance of role modelling** **3) Disjunction between university curricula and the 'real worl**d' **4) Learning in context** - Lack of passion for microbiology & AT

Table 3 - Included Qualitative studies (continued)

Study & location Aim	Study design	Sample	Data collection	Key findings
Students' experiences of learning AT in clinical placements **Ward (2010)** *UK* To explore student's experience of IPC in clinical placements and how this affects learning.	Qualitative, descriptive	Non-probability sample of n=40 nursing & midwifery students (2nd & 3rd year)	Face to face semi-structured interviews	Good AT practices reported (not reusing single use items & maintenance of sterile field) & poor AT practices (reusing single use items, no sterile gloves compromising sterility of IV lines & sterile items) in catheterisation, (IV therapy & wound dressings -Barriers to reporting poor practice-reluctance to challenge due to lack of confidence, repercussions on report & relationships -Community nurses adapted practices & maintained good AT. -Poor role models have positive & negative effects on student's learning & practice
Ward (2011) *UK* To explore nursing students' and mentors' perceptions of student's IPC educational needs.	Qualitative, descriptive	Non-probability sample of n=31 nursing students (2nd & 3rd year) Stratified non-probability sample of n=32 mentors	Semi-structured interviews	-Students confused by conflicting practices -Students seek the 'right way' i.e. 'to set up an IV aseptically' -Students more focused on IPC clinical skills i.e. IV site dressings & ANTT than decision making. -No mention of ANTT assessments in university -Students & mentors identified ANTT assessment would raise standards & identify inappropriate practice
Ward (2012a) *UK* To explore attitudes towards IPCN perceived by nursing students & mentors.	Qualitative	As above	As above	-Students perceived qualified staff to have a negative attitude towards IPC who considered it to be additional workload. -Mentors identified positive attitudes in their areas & organisation but their comments reflected otherwise. -Students practices seen as slow & time consuming. -Mentors perceived there to be time constraints & AT while important should be undertaken more quickly by cutting corners.

Table 3 - Included Qualitative studies (continued)

Study & location Aim	Study design	Sample	Data collection	Key findings
Ward (2012b) *UK* To investigate experiences & education needs of students in relation to IPC in clinical placements (focus of paper- perceptions, views & attitudes towards IPCN	Qualitative exploratory design	As above	As above	**3 themes;** **1) Attitudes towards the IPCN** **2) Effects of the presence of the IPCN** Staff negative attitude towards educational updates, describing them as boring and repetitive. Students more positive, valuing a reminder of good practice. Students stated that staff said they knew how to do things but this was not always evident in their practice "people do forget not just about hand-washing, but AT.." **3) Preferred qualities of the IPCN**
Westphal et al (2014) *USA* To identify common work-arounds & describe what influenced nurses to do this as observed by 4th year nursing students	Qualitative, descriptive	Convenience sample n=96 4th year baccalaureate nursing students' assignments	Students completed 4wk placement where students chose a policy/procedure & observed nurses for deviation from this Analysis of QSEN assignments by team of 3 educators	-IPC themes emerged -1 category related to AT during invasive procedures 3 incidences of AT breaches; **1x during insertion of urinary catheter** (contaminating sterile field, equipment & gloves) **2x during insertion of peripheral venous catheter** (tearing off glove fingertip to palpate vein contaminating cleansed site)

KEY AT- aseptic technique; ANTT- Aseptic Technique Non-Touch Technique; IPC-Infection Prevention Control; IPCN-Infection Prevention Control Nurse; IG- Interactive Group; IM; Intra-Muscular IV; Intra Venous; QSEN- Quality & Safety Education for Nurses

APPENDIX 2- Ethical approval letters

School of Health Care Sciences
Head of School and Dean Professor Sheila Hunt

Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol a Deon Yr Athrawes Sheila Hunt

04 June 2014

Clare Hawker
PhD Student
C/O School of Healthcare Sciences

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Prifysgol Caerdydd
Ty Dewi Sant
Mynydd Bychan
Caerdydd CF14 4XN

Dear Clare

The aseptic technique: What are undergraduate nurse's learning?

Thank you for submitting your proposal to the HCARE PGR Research Review and Ethics Screening Committee for:

- scientific review;

The Committee has now had the opportunity to review your proposal, and is happy to approve your plans with the following comments.

"The studies are very well structured and methodologically sound.

Importance of the study

- No direct evidence is presented to suggest that the teaching of the aseptic technique in HEIs is deficient. The question raised is,
  ' …whether a standardised approach to teaching and learning the aseptic technique is being achieved …'
  Is it appropriate that a standardised approach is taken? The end point competency seems to be the important aspect, but as long as the teaching is aligned to the learning outcome is prescription helpful? Anecdote, and some published evidence, is presented that suggests aseptic technique practice falls below the recognised standards. As a standard exists, would a simple audit approach have more potential for impact than a theoretically-sophisticated research project?
- The aim of the seven studies that 'explored education in the aseptic technique in the university setting' is not clear.

Methodology

- The position of the person who responds to the Phase 1 questions is variable – How problematic is this in terms of introducing bias?
- How will the two HEIs for phase two be selected – is this convenience, expediency or purposive? Does the selection relate to the findings from phase 1?
- I can understand why this may be the case, it seems unfortunate that student participation is dependent upon mentor participation.
- Timeframes for the academic work seem realistic, but I wonder if schedule for earlier activities are optimistic given the amount of liaising with gatekeepers, participants etc involved. There is not much contingency for slippages due to problems gaining research approvals etc.

School of Health Care Sciences
Head of School and Dean Professor Sheila Hunt

Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol a Deon Yr Athrawes Sheila Hunt

06 October 2014

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Clare Hawker
c/o School of Healthcare Sciences
Rm 2.15,
Ty -Dewi -Sant,
Heath Park Campus, Cardiff University
Cardiff

Dear Clare

Aseptic technique: What are undergraduate nursing students learning?

The School's Research Ethic Committee has now considered your research proposal. The decision of the Committee is:

Pass –and that you proceed with your Research after discussing the reviewers' comments with your supervisor

The Committee has asked that the lead reviewers' comments be passed onto you and your supervisors,

- **The scientific value and validity of the proposal:**
  The problem is based in the literature. It is a clinically important area. A rigorous and detailed study design is provided. The second phase aims relate to a complex of factors – will the proposed methods be able to deliver outcomes with clinically significant implications?
- **Justification of the benefit of the study:**
  Based in the literature and on some evidence of poor clinical practices. How learning translates into behaviours remains unclear.
- **Welfare, hazards, discomfort and distress to the participants:**
  A very low risk study. Phase 1 puts the onus on the interviewee to collate quite a lot of information, relating to up to four years of teaching, in readiness for the interview.
- **Consent of the participants:**
  The recruitment strategy is well-described. If the Dean of an HEI gives approval for the study and forwards the most relevant staff member's contact details to the researcher,will that individual then realistically feel some obligation to participate?
  No eligibility criteria are offered for nurse tutors or infection control personnel.
- **Participant information sheet:** Suggest the PIS makes it clear that based on the phase 1 responses, two participating HEIs will be approached to participate in a second phase.
- **Confidentiality:**
  Issues are addressed.
  Is approval for the following likely to be problematic or is this freely available?
  ' Archival records of infection control audits, infection rates and anti-microbial drug usage data will be retrieved to provide contextual information upon infection prevention and control practices in the associated health boards/NHS trusts.'

- **Welfare of Investigator:**
  Very low risk to investigator. May potentially uncover worrying practice.

A good study. The connection of the two phases is not always clear. It does not seem that results from phase 1 are then further explained in phase 2. On what sort of basis is the purposive selection for phase 2 made? Statistical significance? one 'good' and one 'bad' HEI….

This decision will be ratified at the meeting of the School's Research Ethics Committee scheduled to take place on 18 November 2014.

Please note that if there are any subsequent major amendments to the project made following this approval you will be required to submit a revised proposal form. You are advised to contact me if this situation arises. In addition, in line with the University requirements, the project will be monitored on an annual basis by the Committee and an annual monitoring form will be despatched to you in approximately 11 months time. If the project is completed before this time you should contact me to obtain a form for completion.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

Mrs Liz Harmer – Griebel
Research Administration Manager

cc Supervisors – Professor Dinah Gould and Dr Neil Wigglesworth

School of Healthcare Sciences
Head of School and Dean Gail Williams
Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol a Deon Yr Athrawes Gail Williams

22 June 2015

Ms C Hawker
Sandalcroft, 38 Chapel Mead
Penperlleni, Pontypool

NP4 0BR

E-mail E-bost HCAREEthics@cardiff.ac.uk

Dear Ms Hawker

Aseptic technique: What are undergraduate nursing students learning?

I am writing to inform you that the Chair of the Research Ethics Committee has, following consultation, **approved** your revised research proposal. The Committee ratified this decision at its meeting on 18 June 2015.

Please note that if there are any major amendments to the project you will be required to submit a revised proposal form. You are advised to contact me if this situation arises. In addition, in line with the University requirements, the project will be monitored on an annual basis by the Committee and an annual monitoring form will be despatched to you in approximately 11 months' time. If the project is completed before this time you should contact me to obtain a form for completion.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

Liz

Mrs Liz Harmer Griebel
Research Administration Manager

School of Healthcare Sciences
Head of School Gail Williams

Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol Gail Williams

25 June 2015

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Ms C Hawker
Sandalcroft, 38 Chapel Mead
Penperlleni, Pontypool
NP4 0BR

Dear Ms Hawker

Aseptic technique: What are undergraduate nursing students learning?

I am writing to inform you that the Chair of the PGT Research Review and Ethics Committee has following consultation, approved your revised research proposal version 2, 13/5/15, The Committee will ratify this decision at its meeting 14 July 2015.

Please note that if there are any major amendments to the project you will be required to submit a revised proposal form. You are advised to contact me if this situation arises. In addition, in line with the University requirements, the project will be monitored on an annual basis by the Committee and an annual monitoring form will be despatched to you in approximately 11 months' time. If the project is completed before this time you should contact me to obtain a form for completion.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

Mrs Liz Harmer – Griebel
Research Administration Manager

Cc : Professor Dinah Gould

School of Healthcare Sciences
Head of School Gail Williams

Ysgol Gwyddorau Gofal Iechyd
Pennaeth yr Ysgol Gail Williams

05 August 2015

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Ms Clare Hawker
Sandalcroft, 38 Chapel Mead
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Dear *Ms Hawker*

Aseptic technique: What are undergraduate nursing students learning?

At its meeting of *28 July 2015* the School's PGT Research Review and Ethics Committee considered your research proposal. The decision of the Committee is that your work should:

Pass –and that you proceed with your Research

Please note that if there are any subsequent major amendments to the project made following this approval you will be required to submit a revised proposal form. You are advised to contact me if this situation arises. In addition, in line with the University requirements, the project will be monitored on an annual basis by the Committee and an annual monitoring form will be despatched to you in approximately 11 months' time. If the project is completed before this time you should contact me to obtain a form for completion.

Please do not hesitate to contact me if you have any questions.

Yours sincerely

Mrs Liz Harmer – Griebel
Research Administration Manager

APPENDIX 3- Phase one letters, participant information sheets & consent forms

School of Healthcare Sciences
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Dear Dean/Head of faculty of nursing,

I am writing to inform you about a PhD study I am conducting under the supervision of Professor Dinah Gould and Dr Neil Wigglesworth in the School of Healthcare Sciences, Cardiff University. A two phased, mixed methods study is being undertaken to investigate nursing students' learning of the aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes. **Phase one of the study is a national survey of education and training provision in aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes.** Phase two is a case-study for a more in-depth exploration of nursing students' learning of aseptic technique in the university and clinical setting.

I would like to invite your School/Faculty of nursing to participate in phase one of the study. You may at a later date be approached again and invited into phase two of the study. I attach the participant information sheet with detail about phase one of the study. If you agree for your Faculty/School to participate in the study please can you provide contact details for the programme manager/lead for your pre-registration, undergraduate, adult nursing programme or alternatively another staff member who would have the greatest insight into education and training in aseptic technique in this programme.

Thank you in anticipation of your help.

Yours faithfully

Clare Hawker

PARTICIPANT INFORMATION SHEET

Study Title

Aseptic Technique: What are undergraduate nursing students' learning?

Invitation

Dear HEI member,

I would like to invite you as a member of your Higher Education Institute (HEI) to take part in phase one of my PhD study. This is a national survey of education and training in aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes.

Before you make a decision upon whether you would like to participate in the survey I would like you to understand why the study is being conducted and what it would involve. I am happy to go through this information sheet if you so wish and answer any questions you may have (please see my contact details at the end).

The first part of this participant information sheet will tell you the purpose of the study and what will happen if you choose to take part. This is followed by *more detailed information about the conduct of the study.*

What is the purpose of the study?

A safe aseptic technique is essential in the prevention of healthcare-associated infections (HCAIs) and patient safety. Little is known about undergraduate nursing students' learning and understanding of aseptic technique. A two phased, mixed methods PhD study is being conducted to investigate this area. The first phase of the study is this survey. The aim of the survey is to explore what and how undergraduate student nurses learn aseptic technique and how this is assessed in undergraduate, pre-registration, adult nursing programmes. All HEIs delivering NMC approved pre-registration, undergraduate, adult nursing programmes in the UK have been invited to take part in this survey. The survey involves all participating HEIs to be interviewed by telephone on one occasion over a period of six to twelve months.

Why have I been chosen?

You have been approached to take part in the survey because you have been identified by your Head of School/Faculty as being the most appropriate person to complete the survey on behalf of your HEI (this may be as Programme lead/manager for the pre-registration undergraduate adult nursing programme/Lead for clinical skills/simulation). Your participation in the survey is entirely voluntary. Your choice of whether you participate or not in the study will be respected and will not influence your current role or employment within your university.

Who is organising the study?

My name is Clare Hawker and I am currently a full time PhD student and Lecturer in Adult Nursing in the School of Healthcare Sciences at Cardiff University. I am undertaking this PhD study under the supervision of Professor Dinah Gould and Dr Neil Wigglesworth in the School of Healthcare Sciences at Cardiff University.

What would taking part involve?

It would involve you being interviewed by telephone on one occasion at a pre-arranged date and time convenient to you. The telephone interview will last approximately 20-30 minutes. It will involve being asked some initial questions about your undergraduate, pre-registration, adult nursing programme. This will be followed by some specific questions about what and how aseptic technique is taught and assessed in your pre-registration, undergraduate, adult nursing programme.

It would be beneficial to gather any relevant information you might need to answer the survey questions prior to the interview. This might include any curriculum documents, e-learning resources, lesson plans, assessment documents (used in the university or clinical setting) or local health board policies which guide aseptic technique practice. If it is easier, and you and your HEI are willing to share these documents or can identify relevant web links, these can be emailed in advance of the interview. This is likely to reduce the length of the interview. In the event of any missing information during the telephone interview you will be asked at the end of the interview whether you agree to a further follow-up email or telephone call to retrieve any outstanding information.

What are the possible benefits of taking part?

The benefit of you taking part is that your HEI will be represented in the findings of the study. By participating in the survey (phase one of the study) a greater understanding of educational provision and training in aseptic technique will be gained across NMC approved pre-registration, undergraduate, adult nursing programmes in the UK. The survey provides you with the opportunity to showcase and share good practice in the teaching and assessment of aseptic technique within your HEI among the wider community of nurse education. You also have the opportunity to receive a short summary of the survey results when available. HEI s involved in phase one of the study may be approached for phase two of the study. The outcomes of the study as a whole has the potential to develop nurse education in this area and improve aseptic technique practice.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages of taking part in the survey. During the course of the telephone interview, if you are concerned about any questions being asked, you have the option not to answer or to withdraw from the study (see section below- **What will happen if I don't want to carry on taking part?**).

How will information be kept confidential?

All information provided during the study will be kept strictly confidential. Data from the survey will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). Responses to interview questions will be coded and will be made anonymous, so that you and your HEI cannot be identified. Any documentation provided to support the answers to questions within the survey will be used only for research purposes and not be shared, duplicated or reproduced.

What will happen if I don't want to carry on taking part?

You have the right to stop the interview and withdraw from the study at any time without providing any explanation. If you decide to withdraw from the study, this will not affect your role or position within your HEI. If you have any concerns about the study you should contact Clare Hawker within the School of Healthcare Sciences, Cardiff University by telephone on (029) 20687810 or via email: hawkercl@cf.ac.uk. If you have any cause to complain about the way you have been approached or treated during the study you should contact my supervisor- Professor Dinah Gould by telephone on (029)20917804 or via email: Gouldd@cardiff.ac.uk

Who has reviewed this study?

This study has been reviewed and granted ethical approval by the School of Healthcare Sciences Research Ethics Committee, Cardiff University on 6th October 2014. If you would like confirmation of this, please contact Mrs Liz Harmer Griebel (Research Administration Manager) by telephone on (029)20 687552/20 917802 or via email: harmerl@cardiff.ac.uk

What will happen to the results of this study?

When the study is complete a summary of the results of the survey will be made available to participating HEIs. All participating HEIs will be notified via email when the results are available. The findings of the study including survey results will be published in a reputable journal or report in the future. Please be assured that you or your HEI will not be identifiable from any report or publication placed in the public domain.

Contact for further information

If you have any further questions about this study and then please do not hesitate to contact me- Clare Hawker by telephone on(029) 20687810 or via email: hawkercl@cf.ac.uk. If you have any concerns or questions about the study which you do not wish me to know, please contact my supervisor- Professor Dinah Gould by telephone on (029)20917804 or via email: Gouldd@cardiff.ac.uk

Thank you for taking the time to read this participant information sheet and for considering taking part in this study.

HEI/Participant Identification Number:

CONSENT FORM

Title of Project: Aseptic technique: What are undergraduate nursing students learning?

Name of Researcher: Clare Hawker

Please initial box

I confirm that I have read the participant information sheet dated 14/7/14 (version 3) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without affecting my current role, position and employment within my Higher Education Institute. ☐

I understand that any relevant curriculum documents, e-learning resources, lesson plans, assessment documents or local health board policies collected during the study, may be looked at by PhD supervisors in Cardiff University where relevant to the supervision of this study. I give permission for these documents to be used in support of the answers provided to the survey and understand that these will not be shared, duplicated or reproduced. ☐

I understand that data collected from the survey will be made anonymous so that I or my HEI will not be identifiable and that this may be later published or used to support other research in the future. ☐

I understand that the data from the survey will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998(Her Majesty's Stationery Office (HMSO) 2013). ☐

I agree to take part in the above study.

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of Person	Date	Signature

APPENDIX 4- Phase one pre- telephone interview information and structured telephone interview schedule

Thank you for agreeing to be interviewed

To enable you to answer the survey questions accurately you might need to refer to e-learning resources, lesson plans, module/unit and assessment documents or local health board policies which guide aseptic technique practice during the interview (see in bold below). If it is easier, and you and your HEI are willing to share these documents/resources or can identify relevant web links, these can be emailed in advance of the interview.

In order for you to be prepared for the telephone interview please find below the background information required about your undergraduate adult nursing programme and some sample questions.

Background information about your undergraduate adult nursing programme

Award, mode and sites of delivery, programme duration, number of intakes, intake of adult nursing students for 2014/15

Sample questions about the learning, teaching and assessment of aseptic technique in the university and clinical setting across the programme

In which year of the programme is aseptic technique taught/covered?

In year one/two/three of the programme, aseptic technique is taught and applied to what clinical procedures? e.g. wound care

Please briefly outline the content of any taught session (s) or learning resources which help students learn about asepsis/aseptic technique in the first/second/third year. (refer to lesson plans/learning resources)

What is the total time in minutes spent teaching asepsis/aseptic technique in the first/second/third year? (refer to lesson plans)

What key principles of aseptic technique are taught to students? (refer to lesson plans/learning resources)

Are there any specific guidelines/policies which guide the learning and teaching of asepsis/aseptic technique? (refer to guidelines/policies)

What teaching methods and learning resources are used in teaching asepsis/ aseptic technique? (refer to learning resources- videos, e-learning package)

Is knowledge and skill in aseptic technique assessed in the university setting? If so when and how? (module/unit descriptors)

When, what and how is students' competency in aseptic technique assessed in clinical practice throughout the programme? (refer to competency document/skills passport for competency/skill statements)

Structured Telephone Interview Schedule

Project Title: Aseptic technique: What are undergraduate nursing students learning?

HEI Identification Number:

Date & time arranged for interview:

Duration of interview: Comments/Notes

Introduction

Introduce myself- Clare Hawker (Role- Adult Lecturer/PhD student)

Outline the purpose of the survey- This is a national survey of education and training provision in aseptic technique in NMC approved pre-registration, undergraduate adult nursing programmes.

Instructions for the respondent

Thank you for agreeing to take part in this survey, this telephone interview should take approximately 20-30 minutes.

The information provided within the survey is confidential and will be used for the purposes of research only. All information provided will be anonymised, so that you and your organisation/HEI cannot be identified.

Please let me know at any stage during the interview if you would like me to stop the interview and/or you would like to withdraw from the survey.

Section 1 – HEI Pre-registration undergraduate adult programme details

The questions in this section collect relevant background detail about the pre-registration undergraduate adult programme provided in your HEI.

1) What is the award for the undergraduate adult pre-registration nursing programme?

.....(READ OUT) Bachelor of Science (BSc) ( ) 1

(CODE ONE ONLY) Bachelor of Nursing (BN) ( ) 2

Please specify.....Other ( ) 3

2) Is the programme offered on the following basis?

.....(READ OUT) Full-time ( ) 1Go to 3

(CODE ONE ONLY) Part-time ( ) 2

Both full-time & part-time ( ) 3 Go to 3 & 4

3) What is the duration of the full-time programme?

.....(READ OUT) Three years ( ) 1

(CODE ONE ONLY) Four years ( ) 2

Please specify.....Other ( ) 3

4) What is the maximum duration of the part-time programme?

.....(READ OUT) Five years ( ) 1

(CODE ONE ONLY) Seven years ( ) 2

5) How many intakes of students are there per academic year to the programme?

(CODE ONE ONLY) One ( ) 1

Two ( ) 2

More than two ( ) 3

6) Is the same programme delivered in a different location? i.e. satellite site

(CODE ONE ONLY)

Yes ( ) 1Go to 6a &b

No ( ) 2 Go to 7

a) How many different locations/satellite sites?

(CODE ONE ONLY)

One ( ) 1

Two ( ) 2

More than two ( ) 3

b) Are there any differences in facilities or resources across sites which might influence aseptic technique teaching?

Yes ( ) 1

No ( ) 2

7) What is the total intake of adult students to the programme for the academic year 2014/15?

(CODE ONE ONLY)

0-50 ( ) 1

51-100 ( ) 2

101-200 ( ) 3

201-300 ( ) 4

301-400 ( ) 5

401-500 ( ) 6

501-600 ( ) 7

>600 ( ) 8

Section 2 – Learning and teaching of aseptic technique

The questions in this section relate to the content and delivery of learning and teaching of asepsis/aseptic technique within the curriculum.

Reference to curriculum documents, lesson plans or learning resources would be useful to support the answers to the following questions. Any documentary evidence, web links etc. you are willing to share would be useful and will be gratefully received via email/post after the interview.

8) In which year of the programme is aseptic technique taught/covered?

(CODE AS MANY AS APPLY)

Year 1 ( ) 1 Go to 9a, b & c

Year 2 ( ) 2 Go to 10a, b & c

Year 3 ( ) 3 Go to11a, b & c

Year 4 ( ) 3 Go to12a, b & c

9a) In year one of the programme, is aseptic technique taught with application to?

.....(READ OUT)

(CODE AS MANY AS APPLY)

Wound care ( ) 1

Injection technique ( ) 2

urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

9b) What is the total time in minutes spent teaching asepsis/aseptic technique in the first year?

9c) Please briefly outline the content of any taught session (s) or learning resources which help students learn about asepsis/aseptic technique in the first year.

10a) In year two of the programme, is aseptic technique taught with application to?

.....(READ OUT)

(CODE AS MANY AS APPLY)

Wound care ( ) 1

Injection technique ( ) 2

Urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

10b) What is the total time in minutes spent teaching asepsis/aseptic technique in the second year?

10c) Please briefly outline the content of any taught session (s) or learning resources which help students learn about asepsis/aseptic technique in the second year.

11a) In year three of the programme, is aseptic technique taught with application to?

.....(READ OUT)

(CODE AS MANY AS APPLY)

Wound care ( ) 1

Injection technique ( ) 2

Urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

11b) What is the total time in minutes spent teaching asepsis/aseptic technique in the third year?

11c) Please briefly outline the content of any taught session (s) or learning resources which help students learn about asepsis/aseptic technique in the third year.

12a) In year four of the programme, is aseptic technique is taught with application to?

.....(READ OUT)

(CODE AS MANY AS APPLY)

Wound care ( ) 1

Injection technique ( ) 2

Urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

12b) What is the total time in minutes spent teaching asepsis/aseptic technique in the fourth year?

12c) Please briefly outline the content of any taught session (s) or learning resources which help students learn about asepsis/aseptic technique in the fourth year.

13) When students are taught aseptic technique in wound care is this as a?

.....(READ OUT)

(CODE ONE ONLY)

One person technique ( ) 1

Two person technique ( ) 2

Both ( ) 3

Don't know ( ) 4

14a) Are there any specific guidelines which guide the learning and teaching of asepsis/aseptic technique?

(CODE ONE ONLY) Yes ( ) 1 Go to 14 b

No ( ) 2 Go to 15

Don't know ( ) Go to 15

14b) Please identify the guidelines used:

(DO NOT *READ OUT* OPTIONS)

Aseptic Non Touch Technique (ANTT) Clinical practice Framework* ( ) 1

NHS trust/hospital guidelines ( ) 2

Royal Marsden Clinical Nursing Procedures ( ) 3

Please specify.....Other ( ) 4

15) What key principles of aseptic technique are taught to students?

(PROBE BUT DO NOT *READ OUT* OPTIONS)

Asepsis is the aim for all invasive clinical procedures * ( ) 1

Risk assessment of clinical procedures to identify level of aseptic technique needed *( ) 2

Need for Surgical or Standard ANTT to maintain asepsis * ( ) 3

(CODE AS MANY AS APPLY) Disinfect/clean work surfaces ( ) 4

Basic Infective precautions* ( ) 5

Handwashing ( ) 6

Personal protective equipment ( ) 7

Aseptic field management* ( ) 8

Checking sterile items are intact and in date ( ) 9

Identification of key parts and key sites*( ) 10

Protection of key parts and key sites*( ) 11

Only sterile items come into contact with susceptible sites ( ) 12

Non-touch technique* ( ) 13

Preventing cross-infection ( ) 14

Safe disposal of equipment ( ) 15

Please specify.....Other ( ) 16

Don't know ( ) 17

***8 principles/safeguards of ANTT Clinical Practice Framework**

16) Who teaches asepsis/aseptic technique in the university setting?

(**DO NOT *READ OUT* OPTIONS)**

(CODE AS MANY AS APPLY)

HEI lecturers ( ) 1

Associate lecturers ( ) 2

Lecturer practitioners ( ) 3

Practice educators ( ) 4

Skills tutors/facilitators ( ) 5

Infection prevention and control nurses ( ) 6

Students (peer teaching) ( ) 7

Please specify.....Other ( ) 8

Section 3: Learning and Teaching methods

The questions in this section relate to the learning and teaching methods used to teach asepsis/aseptic technique in the university setting.

17a) Do students have to prepare before taught sessions about aseptic technique?

(CODE ONE ONLY) Yes ( ) 1 Go to 17b

No ( ) 2 Go to 18

17b) If yes, which of the following are students expected to access and complete:

.....(READ OUT) e-learning resources ( ) 1

View a video demonstration ( ) 2

Pre-reading ( ) 3

Please specify.....Other ( ) 4

18) Which of the following teaching methods are used in teaching asepsis/ aseptic technique:

.....(READ OUT) Lectures ( ) 1

Simulation/simulated scenarios ( ) 2

(CODE AS MANY AS APPLY) Real time demonstrations ( ) 3

Skills stations ( ) 4

Practical sessions ( ) 5

Peer teaching ( ) 6

Please specify.....Other ( ) 7

19) Do <u>all</u> students get an opportunity to practice performing an aseptic technique?

(**CODE ONE ONLY**) Yes ( ) 1

No ( ) 2

20a) Are students videoed in the practice of aseptic technique?

(**CODE ONE ONLY**) Yes ( ) 1 Go to 20b & c

No ( ) 2 Go to 21

20b) When do students review these videos?

.....(READ OUT) In teaching time ( ) 1 Go to 20c

(**CODE ONE ONLY**) Outside of teaching time ( ) 2 Go to 21

Both ( ) 3 Go to 20c

Please specify.....Other ( ) 4

20c) In teaching time do students get to review these videos?

.....(READ OUT) Independently ( ) 1

(**CODE ONE ONLY**) In small groups (1-10) ( ) 2

As part of a larger group (> 11) ( ) 3

Please specify.....Other ( ) 4

21) How do students receive feedback on their practice of aseptic technique?

.....(READ OUT) Self assessment/reflection ( ) 1

(CODE AS MANY AS APPLY) Facilitator feedback ( ) 2

Peer feedback ( ) 3

Client/service user feedback ( ) 4

Simulated patient/actor feedback ( ) 5

Please specify.....Other ( ) 6

22) Do students have the opportunity to practice aseptic technique in a simulated environment outside of teaching time?

(**CODE ONE ONLY**) Yes ( ) 1

No ( ) 2

Section 4- Assessment of aseptic technique

The next questions relate to assessment of aseptic technique in the university setting.

23a) Is student's knowledge of asepsis/aseptic technique summatively assessed?

(**CODE ONE ONLY**) Yes ( ) 1 Go to 23b &c

No ( ) 2 Go to 24a

23b) In which year(s) of the programme?

First year ( ) 1

(CODE AS MANY AS APPLY) Second year ( ) 2

Third year ( ) 3

Fourth year ( ) 4

Please specify.....Other ( ) 5

23c) Which of the following assessment method(s) are used?

.....(READ OUT) Written exam ( ) 1

Multiple choice questions (MCQ) ( ) 2

Objective structured Clinical Examination (OSCE) ( ) 3

Please specify.....Other ( ) 4

24a) Is student's performance of aseptic technique assessed in the university setting?

(CODE ONE ONLY) Yes ( ) 1 Go to 24b

No ( ) 2 Go to 25

24b) If yes, is this assessment?

.....(READ OUT) formative ( ) 1Go to 24c & d

(CODE AS MANY AS APPLY) summative ( ) 2 Go to 24e & f

24c) If a formative assessment, which method(s) are used?

.....(READ OUT) Self-assessment ( ) 1

(**CODE AS MANY AS APPLY)** Peer assessment ( ) 2

Facilitator/faculty assessment ( ) 3

Service user/client assessment ( ) 4

Please specify.....Other ( ) 5

24d) In which year(s) of the programme?

(**CODE AS MANY AS APPLY)** First year ( ) 1

Second year ( ) 2

Third year ( ) 3

Fourth year ( ) 4

Please specify.....Other ( ) 5

24e) If a summative assessment, which of the following method(s) are used?

(READ OUT) Objective structured clinical examination (OSCE) ( ) 1

(**CODE AS MANY AS APPLY)** Live practical demonstration/assessment ( ) 2

Review & assessment of video performance ( ) 3

Please specify.....Other ( ) 4

24f) In which year(s) of the programme?

First year ( ) 1

(**CODE AS MANY AS APPLY)** Second year ( ) 2

Third year ( ) 3

Fourth year ( ) 4

Please specify.....Other ( ) 5

The next questions relate to assessment of aseptic technique in the clinical setting.

25) Does the programme assess student's achievement of skill or competency in aseptic technique in clinical practice?

(**CODE ONE ONLY)** Yes ( ) 1 Go to 26a

No ( ) 2 Go to the end of the survey

26a) In which year(s) of the programme?

.....(READ OUT) First year ( ) 1 Go to 26b & c

(**CODE AS MANY AS APPLY)** Second year ( ) 2 Go to 26d & e

Third year ( ) 3 Go to 26f & g

Fourth year ( ) 4 Go to 26h & i

Please specify..... Other ( ) 5

26b) In the first year, is competency/skill in aseptic technique in the clinical setting assessed in relation to?

.....(READ OUT) Wound care ( ) 1

Injection technique ( ) 2

(CODE AS MANY AS APPLY) urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

Please specify the skill/ competency statement(s):

26c) Are students required to have the skill or competency/competencies for aseptic technique signed off?

..... (READ OUT)

(CODE ONE ONLY)

Once in every placement ( ) 1

2-3 times in a placement ( ) 2

Once in the year ( ) 3

Please specify.....Other ( ) 4

26d) In the second year, is competency/skill in aseptic technique in the clinical setting assessed in relation to?

.....(READ OUT)

(CODE AS MANY AS APPLY)

Wound care ( ) 1

Injection technique ( ) 2

urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

Please specify the skill/competency statement(s)

26e) Are students required to have the skill or competency/competencies for aseptic technique signed off?

.....(READ OUT)

(CODE ONE ONLY)

Once in every placement ( ) 1

2-3 times in a placement ( ) 2

Once in the year ( ) 3

Please specify.....Other ( ) 4

26f) In the third year, is competency/skill in aseptic technique in the clinical setting assessed in relation to?

.....(READ OUT)

Wound care ( ) 1

Injection technique ( ) 2

(CODE AS MANY AS APPLY) urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

Please specify the skill/competency statement (s)

26g) Are students required to have the skill or competency/competencies for aseptic technique signed?

(READ OUT) Once in every placement ( ) 1

(CODE ONE ONLY) 2-3 times in a placement ( ) 2

Once in the year ( ) 3

Please specify.....Other ( ) 4

26h) In the fourth year, is competency/skill in aseptic technique in the clinical setting assessed in relation to?

..(READ OUT) Wound care ( ) 1

Injection technique ( ) 2

(CODE AS MANY AS APPLY) urinary catheterisation ( ) 3

Care of intravenous infusions and devices ( ) 4

Insertion of peripheral venous cannula ( ) 5

Venepuncture ( ) 6

Please specify.....Other ( ) 7

Please specify the skill/competency statement(s).....

26i) Are students required to have the skill or competency/competencies for aseptic technique signed off?

(READ OUT) Once in every placement ( ) 1

(CODE ONE ONLY) 2-3 times in a placement ( ) 2

Once in the year ( ) 3

Please specify.....Other ( ) 4

27) Is students' competency/skill in aseptic technique in clinical placements assessed by?

.....(READ OUT)

(CODE AS MANY AS APPLY)

Direct observation by mentor ( ) 1

Review of Written evidence (reflection) by mentor ( ) 2

Questioning by mentor ( ) 3

ANTT practical/competency assessment ( ) 4

A Practice teacher ( ) 5

Please specify.....Other ( ) 6

Finally, is there any other information that you could provide which would gain further insight into the education and training of adult nursing students in aseptic technique in NMC approved pre-registration undergraduate programmes?

If you could change 3 things about the way aseptic technique is taught or assessed, what would they be?

1)

2)

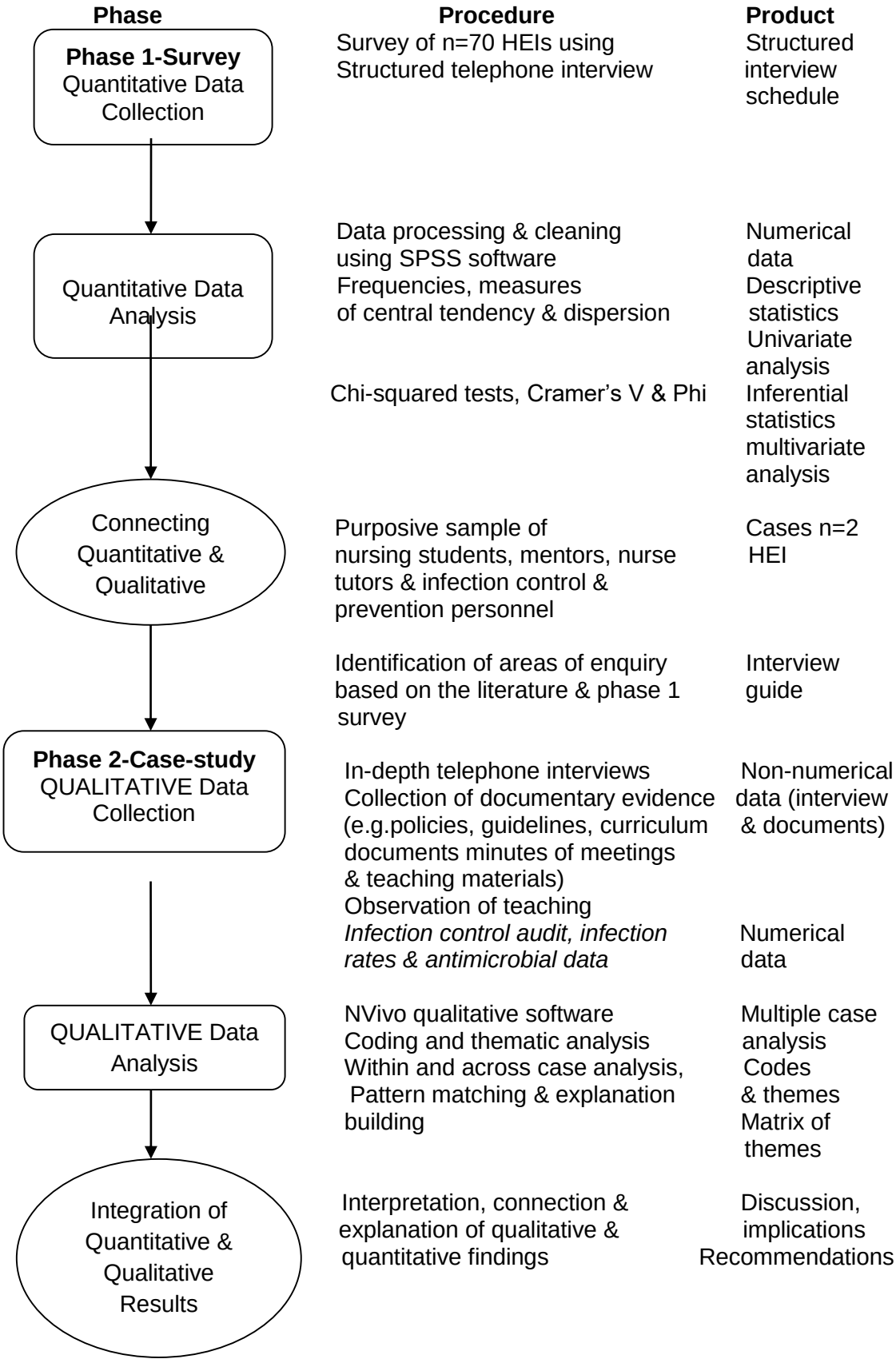
3)

In the event of any missing information during the telephone interview do you agree to a follow-up email or phonecall?

Please CIRCLE ONE YES/ NO

THANK YOU FOR TAKING THE TIME TO COMPLETE THE TELEPHONE SURVEY

APPENDIX 5- A model of the sequential explanatory design
to be used including data collection and analysis procedures (adapted from Ivankova et al 2006)



APPENDIX 6- Scoring of each university against Phase two case-study selection criteria

	Criteria in rank order							
	1. Innovative learning/teaching approaches used in university	**2. Identify use of ANTT guidelines**	**3. Students & qualified staff do same ANTT**	**4. Other performance based criteria assessment used in practice**	**5. Specific competency assessed annually in practice (formative /summative)**	**6. Summative OSCE in university**	**7. Formative OSCE in university**	**8. Other formative assessment in university**
University								
1		√	√		√			
2				√	√			√
3					√			√
4		√				√		
5		√				√		
6		√		√				
7								
8					√			√
9					√			√
10						√		
11					√	√		
12		√		√				
13					√			√
14								
15	√	√				√		√
16								
17		√				√		
18		√						
19					√			
20		√						
21					√			√
22		√						√
23		√						√
24		√						√
25								
26								
27								
28		√			√			

	Criteria in rank order							
	1. Innovative learning/teaching approaches used in university	**2. Identify use of ANTT guidelines**	**3. Students & qualified staff do same ANTT assessment in practice**	**4. Other performance based criteria**	**5. Specific competency /Skill assessed annually in practice (formative /summative)**	**6. Summative OSCE /OSCA /practical**	**7. Formative OSCE in university**	**8. Other formative assessment in university**
University								
29					√			
30								√
31					√			
32					√		√	
33		√			√			
34					√	√		
35		√			√			
36		√			√			√
37								
38								
39		√						
40		√				√		
41						√		√
42		√			√	√		√
43		√						
44		√			√			√
45								
46								
47								
48		√						
49		√						

APPENDIX 7- Phase two letters, participant information sheets & consent forms

Phase 2 student/mentor advertisement/poster

to be on headed paper)

Are you interested in infection prevention and control?

I am currently conducting a PhD research study exploring adult nursing students' learning and understanding of aseptic technique. Your university/health board/NHS Trust has agreed to be a case-study site. In order to understand this important research area I am looking to recruit third year adult nursing students/mentors of third year adult nursing students studying at the named university to the study. If you can spare some time for a telephone interview at a time convenient to you and at no cost to you, please get in touch.

If you would like to find out more about the study and what it would involve please feel free to contact me- Clare Hawker- hawkercl@cf.ac.uk 07837264719

Phase 2 letter/email to Infection control personnel/mentor nurse educators

to be on headed paper)

Dear .....,

I am conducting a two phased, mixed methods PhD study exploring nursing students' learning of aseptic technique. The Named University and the associated named health boards/NHS trusts have been chosen and approval granted for them to be a case-study site for the second phase of this study.

I would like to invite you as an Infection Prevention and Control team member/mentor of a third year student/nurse educator working within the named university or named health board/NHS trust to take part in the case-study. The case-study aims to achieve an in-depth exploration of nursing students' learning of aseptic technique and contextual factors that affect their learning in the university and clinical setting. Please find attached/enclosed a participant information sheet for further information about the study. If you would like to discuss the study please get in touch with me.

Thank you in anticipation of your help.

Yours faithfully

Clare Hawker

PARTICIPANT INFORMATION SHEET

Study Title

Aseptic Technique: What are undergraduate nursing students' learning?

Invitation

Dear Student,

I would like to invite you as a third year adult nursing student to take part in phase two of my PhD study. This is a case-study exploring your learning of aseptic technique and what is generally understood by the term 'aseptic technique'.

Before you make a decision upon whether you would like to participate in the study I would like you to understand why the study is being conducted and what it would involve. I am happy to go through this information sheet if you so wish and answer any questions you may have (please see my contact details at the end).

The first part of this participant information sheet will tell you the purpose of the study and what will happen if you choose to take part. *This is followed by* more detailed information about the conduct of the study.

What is the purpose of the study?

A safe aseptic technique is essential in the prevention of healthcare-associated infections (HCAIs) and patient safety. Little is known about undergraduate nursing students' learning and understanding of aseptic technique. A two phased, mixed methods PhD study is being conducted to investigate this area. The first phase of the study was a national survey of educational and training provision in aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes. The aim of this phase of the study (phase two) is to investigate what is understood by the term 'aseptic technique' and explore nursing students' experiences of learning aseptic technique within the university and clinical setting.

As a third year nursing student undertaking an NMC approved pre-registration, undergraduate, adult nursing programmes you have been invited to take part in this phase of the study. The study would involve you being interviewed on one occasion.

Why have I been chosen?

You have been chosen and invited to take part as you are in the third year of your pre-registration, undergraduate, adult nursing programme studying at the named university. At this stage of your programme you will have experienced learning and practising the aseptic technique within the university and clinical setting. Your university and the named health board/NHS trust have been chosen as a case-study site for the second phase of this study. Your participation in the study is

entirely voluntary. Your choice of whether you participate or not in the study will be respected and will not influence your current studies as a nursing student at university.

Who is organising the study?

My name is Clare Hawker and I am currently a full time PhD student and Lecturer in Adult Nursing in the School of Healthcare Sciences at Cardiff University. I am undertaking this PhD study under the supervision of Professor Dinah Gould and Professor Molly Courtenay in the School of Healthcare Sciences at Cardiff University.

What would taking part involve?

It would involve you being interviewed by telephone on one occasion at a date and time convenient to you. The telephone interview will last approximately 30-45 minutes and will be audio-recorded to capture the discussion for later analysis.

The interview will explore your understanding of aseptic technique and perspective upon learning aseptic technique in the university and clinical setting. The interview will be guided but there will be plenty of opportunity for you to discuss any relevant issues.

What are the possible benefits of taking part?

The benefit of you taking part as a student is that you have an opportunity to share your experiences of learning aseptic technique in the university and clinical setting. Your insight is invaluable and may help to influence how aseptic technique is taught and assessed in NMC approved pre-registration, undergraduate, adult nursing programmes in the UK in the future. You are therefore, making a positive contribution to improving aseptic technique practices and the quality of care provided to patients. You will also have the opportunity to receive a short summary of the study's findings when available.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages of taking part in the study. During the course of the interview, if you are concerned about any questions being asked, you have the option not to answer or to withdraw from the study (see section below- What will happen if I don't want to carry on taking part?).

How will information be kept confidential?

All information provided during the study will be kept strictly confidential. Interview data will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). All interview data will be made anonymous so that you, your university and clinical placement area cannot be identified. Please note, however, that in the event that a serious patient safety issue or concern related to poor practice is identified during the interview, this would need to be reported for the

organisation to take action on. This might compromise your anonymity. Direct quotes from your interview may be used in the thesis, journal articles and in conference presentations but your identity will remain anonymous.

What will happen if I don't want to carry on taking part?

You have the right to stop the interview and withdraw from the study at any time without providing any explanation. If you decide to withdraw from the study, this will not affect your studies as a student on the pre-registration adult nursing programme. If you have any concerns about the study you should contact Clare Hawker within the School of Healthcare Sciences, Cardiff University by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any cause to complain about the way you have been approached or treated during the study you should contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563or via email: Gouldd@cardiff.ac.uk

Who has reviewed this study?

This study has been reviewed and granted ethical approval by the School of Healthcare Sciences Research Ethics Committee, Cardiff University on 6th October 2014 and minor were amendments approved on 18th June 2015 and 28th July 2015. If you would like confirmation of this please contact Mrs Liz Harmer Griebel (Research Administration Manager) by telephone on (029) 20 687552 or via email: harmerl@cardiff.ac.uk

What will happen to the results of this study?

When the study is complete a summary of the results of the study will be made available to all participants. All participating students will be notified via email when the results are available. The findings of the study will be published in a reputable journal or report in the future. Please be assured that you, your university and the clinical placement area will not be identifiable from any report or publication placed in the public domain.

Contact for further information

If you have any further questions about this study and then please do not hesitate to contact me- Clare Hawker by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any concerns or questions about the study which you do not wish me to know, please contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Thank you for taking the time to read this participant information sheet and for considering taking part in this study

PARTICIPANT INFORMATION SHEET

Study Title

Aseptic Technique: What are undergraduate nursing students' learning?

Invitation

Dear Mentor,

I would like to invite you as a mentor to a third year adult nursing student to take part in phase two of my PhD study. This is a case-study exploring nursing students' learning of aseptic technique and what is generally understood by the term 'aseptic technique'.

Before you make a decision upon whether you would like to participate in the study I would like you to understand why the study is being conducted and what it would involve. I am happy to go through this information sheet if you so wish and answer any questions you may have (please see my contact details at the end).

The first part of this participant information sheet will tell you the purpose of the study and what will happen if you choose to take part. *This is followed by* more detailed information about the conduct of the study.

What is the purpose of the study?

A safe aseptic technique is essential in the prevention of healthcare-associated infections (HCAIs) and patient safety. Little is known about undergraduate nursing students' learning and understanding of aseptic technique. A two phased, mixed methods PhD study is being conducted to investigate this area. The first phase of the study was a national survey of educational and training provision in aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes. The aim of this phase of the study (phase two) is to investigate what is understood by the term 'aseptic technique' and explore nursing students' experiences of learning aseptic technique within the university and clinical setting.

As a mentor to a third year nursing student undertaking an NMC approved pre-registration, undergraduate, adult nursing programme you have been invited to take part in this phase of the study. The study would involve you being interviewed on one occasion.

Why have I been chosen?

You have been approached to take part in phase two of the study because you have been identified as being a mentor to a third year, adult nursing student on placement in the clinical area where you are employed as a qualified nurse in named health board/trust. The Named University and the named health board/NHS trust have been chosen as a case-study site for the second phase of this study. Your participation in the

study is entirely voluntary. Your choice of whether you participate or not in the study will be respected and will not influence your current role as a health professional or employment within your health board/NHS trust.

Who is organising the study?

My name is Clare Hawker and I am currently a full time PhD student and Lecturer in Adult Nursing in the School of Healthcare Sciences at Cardiff University. I am undertaking this PhD study under the supervision of Professor Dinah Gould and Professor Molly Courtenay in the School of Healthcare Sciences at Cardiff University.

What would taking part involve?

It would involve you being interviewed by telephone on one occasion at a date and time convenient to you. The telephone interview will last approximately 30-45 minutes and will be audio-recorded to capture the discussion for later analysis.

The interview will explore your understanding of aseptic technique and perspective on teaching, supervising and assessing students when undertaking aseptic technique in the clinical setting. The interview will be guided but there will be plenty of opportunity for you to discuss any relevant issues.

What are the possible benefits of taking part?

The benefit of you taking part as a mentor is that you have an opportunity to share your experiences of teaching, supervising and assessing nursing students in aseptic technique in the clinical setting. Your insight is invaluable and may help to influence how aseptic technique is taught and assessed in NMC approved pre-registration, undergraduate, adult nursing programmes in the UK in the future. You are therefore, making a positive contribution to improving aseptic technique practices and the quality of care provided to patients. You will also have the opportunity to receive a short summary of the study's findings when available.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages of taking part in the study. During the course of the interview, if you are concerned about any questions being asked, you have the option not to answer or to withdraw from the study (see section below- What will happen if I don't want to carry on taking part?).

How will information be kept confidential?

All information provided during the study will be kept strictly confidential. Interview data will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). All interview data will be made anonymous so that you, your allocated student, the university, clinical area and Health board/NHS trust cannot be identified. Please note however that in the event that a serious patient safety issue or concern related to poor practice is identified during the interview, this would need to be reported for the organisation to take action on. This might compromise your anonymity. Direct

quotes from your interview may be used in the thesis, journal articles and in conference presentations but your identity will remain anonymous.

What will happen if I don't want to carry on taking part?

You have the right to stop the interview and withdraw from the study at any time without providing any explanation. If you decide to withdraw from the study, this will not affect your role as a health professional or employment with the Health board/NHS trust. If you have any concerns about the study you should contact Clare Hawker within the School of Healthcare Sciences, Cardiff University by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any cause to complain about the way you have been approached or treated during the study you should contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Who has reviewed this study?

This study has been reviewed and granted ethical approval by the School of Healthcare Sciences Research Ethics Committee, Cardiff University on 6th October 2014 and minor amendments were approved on 18th June 2015 and 28th July 2015. If you would like confirmation of this please contact Mrs Liz Harmer Griebel (Research Administration Manager) by telephone on (029) 20 687552 or via email: harmerl@cardiff.ac.uk

What will happen to the results of this study?

When the study is complete a summary of the results of the study will be made available to all participants. All participating mentors will be notified via email when the results are available. The findings of the study will be published in a reputable journal or report in the future. Please be assured that you, your student, the clinical area or the Health board/NHS trust and the university will not be identifiable from any report or publication placed in the public domain.

Contact for further information

If you have any further questions about this study and then please do not hesitate to contact me- Clare Hawker by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any concerns or questions about the study which you do not wish me to know, please contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Thank you for taking the time to read this participant information sheet and for considering taking part in this study.

PARTICIPANT INFORMATION SHEET

Study Title

Aseptic Technique: What are undergraduate nursing students' learning?

Invitation

Dear Infection Prevention and Control team member,

I would like to invite you as an Infection Prevention and Control team member to take part in phase two of my PhD study. This is a case-study exploring student nurses' learning of aseptic technique and what is generally understood by the term 'aseptic technique'.

Before you make a decision upon whether you would like to participate in the study I would like you to understand why the study is being conducted and what it would involve. I am happy to go through this information sheet if you so wish and answer any questions you may have (please see my contact details at the end).

The first part of this participant information sheet will tell you the purpose of the study and what will happen if you choose to take part. *This is followed by* more detailed information about the conduct of the study.

What is the purpose of the study?

A safe aseptic technique is essential in the prevention of healthcare-associated infections (HCAIs) and patient safety. Little is known about undergraduate nursing students' learning and understanding of aseptic technique. A two phased, mixed methods PhD study is being conducted to investigate this area. The first phase of the study was a national survey of educational and training provision in aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes. The aim of this phase of the study (phase two) is to investigate what is understood by the term 'aseptic technique' and explore nursing students' experiences of learning aseptic technique within the university and clinical setting.

As an Infection prevention and control team member who may be involved in the planning and delivery of education and training in aseptic technique in the university and/or clinical you have been invited to take part in this phase of the study. The study would involve you being interviewed on one occasion.

Why have I been chosen?

You have been approached to take part in phase two of the study because you have been identified as being a member of the Infection prevention and Control team member within the named Health board/NHS Trust. The Named University and the named health board/NHS trust have been chosen as a case-study site for

the second phase of this study. Your participation in the study is entirely voluntary. Your choice of whether you participate or not in the study will be respected and will not influence your current role as a health professional or employment within your Health board/NHS Trust. You may have previously participated in phase one of the study but it will not be presumed that you are also willing to take part in phase two of the study.

Who is organising the study?

My name is Clare Hawker and I am currently a full time PhD student and Lecturer in Adult Nursing in the School of Healthcare Sciences at Cardiff University. I am undertaking this PhD study under the supervision of Professor Dinah Gould and Professor Molly Courtenay in the School of Healthcare Sciences at Cardiff University.

What would taking part involve?

It would involve you being interviewed by telephone on one occasion at a date and time convenient to you. The telephone interview will last approximately 30-45 minutes and will be audio-recorded to capture the discussion for later analysis.

The interview will explore your understanding of aseptic technique and your involvement in the education, training and assessment of nursing students in aseptic technique in the university and clinical setting. The interview will be guided but there will be plenty of opportunity for you to discuss any relevant issues.

What are the possible benefits of taking part?

The benefit of you taking part as an Infection prevention and Control team member is that you have a unique opportunity to share your experiences of education, training and practices of aseptic technique in the university and clinical setting. Your insight is invaluable and may help to influence how aseptic technique is taught and assessed across NMC approved pre-registration, undergraduate, adult nursing programmes in the UK in the future. You are therefore, making a positive contribution to improving aseptic technique practices and the quality of care provided to patients. You will also have the opportunity to receive a short summary of the study's findings when available.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages of taking part in the study. During the course of the interview, if you are concerned about any questions being asked, you have the option not to answer or to withdraw from the study (see section below- What will happen if I don't want to carry on taking part?).

How will information be kept confidential?

All information provided during the study will be kept strictly confidential. Interview data will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's

Stationery Office (HMSO) 2013). All interview data will be made anonymous so that you, the university and your Health board/NHS trust cannot be identified. Please note, however, that in the event that a serious patient safety issue or concern related to poor practice is identified during the interview, this would need to be reported for the organisation to take action on. This might compromise your anonymity. Direct quotes from your interview may be used in the thesis, journal articles and in conference presentations but your identity will remain anonymous.

What will happen if I don't want to carry on taking part?

You have the right to stop the interview and withdraw from the study at any time without providing any explanation. If you decide to withdraw from the study, this will not affect your role as a health professional or employment with the Health board/NHS trust. If you have any concerns about the study you should contact Clare Hawker within the School of Healthcare Sciences, Cardiff University by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any cause to complain about the way you have been approached or treated during the study you should contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Who has reviewed this study?

This study has been reviewed and granted ethical approval by the School of Healthcare Sciences Research Ethics Committee, Cardiff University on 6th October 2014 and minor amendments were approved on 18th June 2015 and 28th July 2015. If you would like confirmation of this please contact Mrs Liz Harmer Griebel (Research Administration Manager) by telephone on (029) 20 687552 or via email: harmerl@cardiff.ac.uk

What will happen to the results of this study?

When the study is complete a summary of the results of the study will be made available to all participants. All participating Infection prevention and control team members will be notified via email when the results are available. The findings of the study will be published in a reputable journal or report in the future. Please be assured that you, the Health board/NHS trust and the university will not be identifiable from any report or publication placed in the public domain.

Contact for further information

If you have any further questions about this study and then please do not hesitate to contact me- Clare Hawker by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any concerns or questions about the study which you do not wish me to know, please contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Thank you for taking the time to read this participant information sheet and for considering taking part in this study.

PARTICIPANT INFORMATION SHEET

Study Title

Aseptic Technique: What are undergraduate nursing students' learning?

Invitation

Dear HEI member,

I would like to invite you as a Higher Education Institute (HEI) member of staff to take part in phase two of my PhD study. This is a case-study exploring nursing students' learning of aseptic technique and what is generally understood by the term 'aseptic technique'.

Before you make a decision upon whether you would like to participate in the study I would like you to understand why the study is being conducted and what it would involve. I am happy to go through this information sheet if you so wish and answer any questions you may have (please see my contact details at the end).

The first part of this participant information sheet will tell you the purpose of the study and what will happen if you choose to take part. *This is followed by* more detailed information about the conduct of the study.

What is the purpose of the study?

A safe aseptic technique is essential in the prevention of healthcare-associated infections (HCAIs) and patient safety. Little is known about undergraduate nursing students' learning and understanding of aseptic technique. A two phased, mixed methods PhD study is being conducted to investigate this area. The first phase of the study was a national survey of educational and training provision in aseptic technique in NMC approved pre-registration, undergraduate, adult nursing programmes. The aim of this phase of the study (phase two) is to investigate what is understood by the term 'aseptic technique' and explore nursing students' experiences of learning aseptic technique within the university and clinical setting.

As a HEI member who may be responsible or directly involved in either the delivery and/or planning of the curriculum in relation to aseptic technique you have been invited to take part in this phase of the study. The study would involve you being interviewed on one occasion.

Why have I been chosen?

You have been approached to take part in phase two of the study because you have been identified as being responsible or directly involved in the delivery and/or

planning of the curriculum in relation to aseptic technique. The Named University and the named health board/NHS trusts have been chosen as a case-study site for the second phase of this study. Your participation in the study is entirely voluntary. Your choice of whether you participate or not in the study will be respected and will not influence your current role or employment within your university. You may have previously participated in phase one of the study but it will not be presumed that you are also willing to take part in phase two of the study.

Who is organising the study?

My name is Clare Hawker and I am currently a full time PhD student and Lecturer in Adult Nursing in the School of Healthcare Sciences at Cardiff University. I am undertaking this PhD study under the supervision of Professor Dinah Gould and Professor Molly Courtenay in the School of Healthcare Sciences at Cardiff University.

What would taking part involve?

It would involve you being interviewed by telephone on one occasion at a date and time convenient to you. The telephone interview will last approximately 30-45 minutes and will be audio-recorded to capture the discussion for later analysis.

The interview will explore your understanding of aseptic technique and your perspective on being directly involved in teaching, supervising and assessing nursing students when learning aseptic technique in the university setting and/or being involved in curriculum planning in this area. The interview will be guided but there will be plenty of opportunity for you to discuss any relevant issues.

What are the possible benefits of taking part?

The benefit of you taking part as a HEI member is that you have an opportunity to share your experiences of teaching, supervising and assessing nursing students in aseptic technique in the university setting and/or of curriculum planning in this area. Your insight is invaluable and may help to influence how aseptic technique is taught and assessed across NMC approved pre-registration, undergraduate nursing programmes in the UK in the future. You are therefore, making a positive contribution to improving aseptic technique practices and the quality of care provided to patients. You will also have the opportunity to receive a short summary of the study's findings when available.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages of taking part in the study. During the course of the interview, if you are concerned about any questions being asked, you have the option not to answer or to withdraw from the study (see section below- What will happen if I don't want to carry on taking part?).

How will information be kept confidential?

All information provided during the study will be kept strictly confidential. Interview data will be kept in a locked cabinet or on a password protected computer for a

minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). All interview data will be made anonymous so that you and your university and associated health board/NHS trust cannot be identified. Please note however that in the event that a serious patient safety issue or concern related to poor practice is identified during the interview, this would need to be reported for the organisation to take action on. This might compromise your anonymity. Direct quotes from your interview may be used in the thesis, journal articles and in conference presentations but your identity will remain anonymous.

What will happen if I don't want to carry on taking part?

You have the right to stop the interview and withdraw from the study at any time without providing any explanation. If you decide to withdraw from the study, this will not affect your role as a health professional or employment with the university. If you have any concerns about the study you should contact Clare Hawker within the School of Healthcare Sciences, Cardiff University by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any cause to complain about the way you have been approached or treated during the study you should contact my supervisor- Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Who has reviewed this study?

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What will happen to the results of this study?

When the study is complete a summary of the results of the study will be made available to all participants. All participating HEI members will be notified via email when the results are available. The findings of the study will be published in a reputable journal or report in the future. Please be assured that you, the university and associated Health board will not be identifiable from any report or publication placed in the public domain.

Contact for further information

If you have any further questions about this study and then please do not hesitate to contact me- Clare Hawker by telephone on (029) 20 687810/ Mobile 07837264719 or via email: hawkercl@cf.ac.uk. If you have any concerns or questions about the study which you do not wish me to know, please contact my supervisor Professor Dinah Gould by telephone on (029) 20688563 or via email: Gouldd@cardiff.ac.uk

Thank you for taking the time to read this participant information sheet and for considering taking part in this study

Participant Identification Number:

STUDENT CONSENT FORM

Title of Project: Aseptic technique: What are undergraduate nursing students' learning?

Name of Researcher: Clare Hawker

Please initial the box

I confirm that I have read the participant information sheet dated 28/7/15 (version 5) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without affecting my current studies as a nursing student at my university. ☐

I understand that interview data will be made anonymous so that I or my university and clinical placement area will not be identifiable and that this data may be later published or used to support other research in the future. ☐

I understand that direct quotes from the interview may be used in the thesis, journal articles and in conference presentations but my identity will remain anonymous. ☐

I understand that in the event of identifying a serious patient safety issue or concern related to poor practice during the interview, this would need to be reported for the organisation to take action on, and this might compromise my anonymity. ☐

I understand that data from the study will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). ☐

I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person	Date	Signature

Participant Identification Number:

MENTOR CONSENT FORM

Title of Project: Aseptic technique: What are undergraduate nursing students' learning?

Name of Researcher: Clare Hawker

Please initial the box

I confirm that I have read the participant information sheet dated 28/7/15 (version 5) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without affecting my current role as a health professional and employment in the Health board/NHS Trust. ☐

I understand that interview data will be made anonymous so that I, or the clinical area withinthe health board and university student and university will not be identifiable and that this data may be later published or used to support other research in the future. ☐

I understand that direct quotes from the interview may be used in the thesis, journal articles and in conference presentations but my identity will remain anonymous. ☐

I understand that in the event of identifying a serious patient safety issue or concern related to poor practice during the interview, this would need to be reported for the organisation to take action on, and this might compromise my anonymity. ☐

I understand that data from the study will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). ☐

I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person	Date	Signature

Participant Identification Number:

INFECTION PREVENTION AND CONTROL NURSE CONSENT FORM

Title of Project: Aseptic technique: What are undergraduate nursing students' learning?

Name of Researcher: Clare Hawker

Please initial the box

I confirm that I have read the participant information sheet dated 28/7/15 (version 5) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without affecting my current role as a health professional and employment in the Health board/NHS trust. ☐

I understand that interview data will be made anonymous so that I or the HealthBoard/NHS trust and university will not be identifiable and that this data may be later published or used to support other research in the future. ☐

I understand that direct quotes from the interview may be used in the thesis, journal articles and in conference presentations but my identity will remain anonymous.

I understand that in the event of identifying a serious patient safety issue or concern related to poor practice during the interview, this would need to be reported for the organisation to take action on, and this might compromise my anonymity. ☐

I understand that data from the study will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). ☐

I agree to take part in the above study. ☐

Name of Participant	Date	Signature

Name of Person	Date	Signature

Participant Identification Number:

HEI STAFF CONSENT FORM

Title of Project: Aseptic technique: What are undergraduate nursing students' learning?

Name of Researcher: Clare Hawker

Please initial the box

I confirm that I have read the participant information sheet date 28/7/15 (version 5) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without affecting my current role, position and employment in the university. ☐

I understand that interview data will be made anonymous so that I or the university or the associated Health Board/NHS trust will not be identifiable and that this data may be later published or used to support other research in the future. ☐

I understand that direct quotes from the interview may be used in the thesis, journal articles and in conference presentations but my identity will remain anonymous. ☐

I understand that in the event of identifying a serious patient safety issue or concern related to poor practice during the interview, this would need to be reported for the organisation to take action on, and this might compromise my anonymity. ☐

I understand that data from the study will be kept in a locked cabinet or on a password protected computer for a minimum of 15 years in accordance with the Research Framework for Cardiff University (Cardiff University 2011) and the Data Protection Act 1998 (Her Majesty's Stationery Office (HMSO) 2013). ☐

I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person	Date	Signature

APPENDIX 8- Phase two case-study protocol

Overview of the case-study

Background information about the case-study

Little is known about nursing students' learning of aseptic technique in the university or clinical setting within the current literature. Nursing students' understanding and practice of aseptic technique may be shaped by learning within these different settings or communities of practice. The transfer of knowledge and skills in aseptic technique from the university to the clinical setting has not yet been explored.

Aim of the embedded multiple case-study

To conduct an in-depth exploration of the contextual factors that influence nursing students' learning and understanding of aseptic technique and the transfer of knowledge and skills from the university to the clinical setting.

Goals of the case-study

- To explore understanding of the term 'aseptic technique' from the perspective of the providers and recipients of undergraduate pre-registration nurse education.
- To investigate the contextual factors that influence learning of aseptic technique within the university setting and the impact upon nursing students' learning.
- To investigate the contextual factors that influence practice of aseptic technique within the clinical setting and the impact upon nursing students' learning.
- To explore the relationship between HEIs and their associated health board/NHS trust and implications upon the learning and practice of aseptic technique.
- To explore factors that might influence the transfer of knowledge and skills in aseptic technique from the university to the clinical setting.

Rationale for selecting the cases

The cases will be two higher education institutes and their associated health boards/NHS trusts. The cases will be chosen from only those higher education institutes who completed phase one of the study. The selection of cases will therefore not be made until the end of phase one of the study. The selection of cases will be purposive, based on the findings of the phase one survey but geographically accessible.

Policy relevance

Department of Health (2006) The Health and Social Care Act 2006: Code of Practice for the control of Health Care Associated Infections and Department of Health (2010) The Health and Social Care Act 2008: Code of Practice for the control of infections and related guidance states that all healthcare workers undertaking

aseptic technique should be educated, trained and assessed and perform a standardised technique with compliance being audited.

Aseptic Non-Touch Technique (ANNT) Clinical practice framework (The - Association for Safe Aseptic Practice (ASAP) 2013) aims to achieve a safe and standardised approach to performing aseptic technique nationally and internationally through education and training.

epic 3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England (Loveday et al 2014) new recommendations are as follows; 1)for the provision of education and training in aseptic technique by organisations to ensure healthcare workers competently perform aseptic technique 2) Aseptic technique should be used for all procedures that breach the natural defences of the body which includes insertion and maintenance of all invasive devices, infusion of sterile fluids and medication and care of wounds and surgical incisions.

Theoretical framework(s)

A combination of Social Learning Theories will guide and inform the study, Bandura's Social Learning Theory (Bandura 1975); Situated learning theory (Lave and Wenger 1991) and Communities of Practice (Wenger 1998). Bandura's Social Learning Theory (Bandura 1977) proposes that learning takes places through observation, with the term 'observational learning' frequently associated with this theory. Modelling, imitation and reinforcement are central tenets of Bandura's Learning Theory (Bandura 1975). Situated learning theory (Lave and Wenger 1991) is an expansion of experiential learning whereby students develop their knowledge through their participation in social structures. Situated learning is learning that is situated in a specific context and embedded within a particular social and physical environment. Wenger (1998) insists that communities of practice help to provide meaning and contextualise learning. When students are 'learning by doing' in a 'community of practice' they participate in conversations and behaviour that helps to contextualise knowledge and give it significance.

Theoretical propositions

- Student's understanding (meaning) and practice of aseptic technique is contexualised within the different 'communities of practice' of the university and clinical setting.
- Learning in the 'community of practice' in the university setting assists students to develop knowledge and skills in aseptic technique and provide meaning through 'learning by doing' and co-participation.
- Students engage in learning and the practice of aseptic technique within the boundaries of the different communities of practice in the university and clinical setting.
- Poor role modelling of aseptic technique in clinical practice influences student's learning and practice of aseptic technique.

- Students may adopt good or poor aseptic technique practices depending on the role models observed in their clinical placement in order to belong and become participating members of that community of practice.
- Aseptic technique practices learnt in the university setting are only legitimatised and behaviour/practices reinforced if similar practices are observed in the clinical setting.
- Knowledge and skill transfer of aseptic technique from the university to the clinical setting is aided where the learning context in the university setting is authentic and replicates the clinical settings and situations in which aseptic technique is practised.

Data collection procedures

- Names of contact persons for doing fieldwork
- The names of contact people cannot be specified until the end of phase one of the study but will include the following;
- Lead/Senior nurses for infection prevention and control teams for the health boards/NHS trusts associated with the two selected HEIs
- Programme leads/managers for the undergraduate adult pre-registration programme in the two HEIs
- Directors for student placements in the two HEIs
- Ward/unit managers, Mentor links and HEI links depending on placement allocation of students recruited to the study

Data collection plan

The data collection plan is the same for both cases in order to explore similarities and differences between the two cases. The timescales and schedule for data collection cannot be confirmed until phase one data collection is complete. The intention is to gather data from each case-study in turn to immerse the researcher in data from the individual cases. The single case needs to be fully understood before cross comparisons between cases can be explored.

Case 1

Time scale	Activity
	Contact key people (Infection prevention & control team, programme leads, Directors for student placements, after Research & Development approval informing them of the study.
	Place advert on university virtual learning environment/student website to invite and recruit 3rd year students to the study. Once students have agreed to take part. Contact mentor links & unit managers in their placement area to inform them about the study.
	Approach and recruit mentors to the study
	Interview students and mentors
	Approach and recruit infection prevention and control personnel to the study
	Interview infection prevention and control personnel
	Gather relevant infection control policies, infection rates and antimicrobial data and infection prevention and control audits
	Contact lecturers/HEI staff who are responsible and involved in both the planning and delivery of education and training in aseptic technique in the university setting identified by programme manager/lead. Invite and recruit into the study
	Interview HEI staff and others involved in the planning and delivery of aseptic technique education and training
	Gather relevant curriculum documents, teaching materials and lesson plans
	Observe relevant teaching/simulated sessions upon aseptic technique
	Gather evidence of partnership working between the HEI and associated health board/NHS trust- review minutes of meetings, policies, roles, development of resources for education and training in aseptic technique, memorandum of agreements

Resources needed	Date of action	Details/comments
Working audio -recorder		
Laptop/tablet		
Notebook, paper and pens		
Private room for interviewing		
Signage for room ‘interview in progress’		
Identifying copying/scanning facilities for documents		
Wallets/folders to secure and store relevant documents collected		

Case 2

Time scale	Activity
	Contact key people (Infection prevention & control team, programme leads, Directors for student placements, after Research & Development approval informing them of the study.
	Place advert on student virtual learning environment/platform to invite and recruit 3rd year students to the study. Once students have agreed to take part. Contact mentor links & unit managers in their placement area to inform them about the study.
	Approach and recruit mentors to the study
	Interview students and mentors
	Approach and recruit infection prevention and control personnel to the study
	Interview infection prevention and control personnel
	Gather relevant infection control policies, infection rates and antimicrobial data and infection prevention and control audits
	Contact lecturers/HEI staff who are responsible and involved in both the planning and delivery of education and training in aseptic technique in the university setting identified by programme manager/lead. Invite and recruit into the study
	Interview HEI staff and others involved in the planning and delivery of aseptic technique education and training
	Gather relevant curriculum documents, teaching materials and lesson plans
	Observe relevant teaching/simulated sessions upon aseptic technique
	Gather evidence of partnership working between the HEI and associated health board/NHS trust- review minutes of meetings, policies, roles, development of resources for education and training in aseptic technique, memorandum of agreements

Resources needed	Date of action	Details/comments
Working audio -recorder		
Laptop/tablet		
Notebook, paper and pens		
Private room for interviewing		
Signage for room ‘interview in progress’		
Identifying copying/scanning facilities for documents		
Wallets/folders to secure and store relevant documents collected		

Expected preparation prior to fieldwork

- Gain ethical approval and research and development approval to access NHS sites and staff
- Attend Interviewing training and techniques
- Conduct pilot interviews
- Search for any relevant policies and infection rates for the health boards/NHS trusts in the public domain

Data Collection questions

Level 1: Sample questions asked of interviewees

- What is your understanding of the term ‘aseptic technique’?
- What principles guide your practice of aseptic technique?
- How important is aseptic technique in patient care?
- What are your experiences of learning/teaching/practice of aseptic technique in the university setting?
- What are your experiences of learning aseptic technique in the clinical setting? (student)
- What are your experiences of learning aseptic technique in the university setting? (student)
- What are your experiences of teaching aseptic technique in the clinical setting?(mentor)
- What are your experiences of teaching aseptic technique in the university setting? (HEI member, Infection prevention & control team member)
- What are your experiences of aseptic technique practice in the university setting? (student, Infection prevention & control team member and HEI member)
- What are your experiences of aseptic technique practice in the clinical setting? (student, mentor , Infection prevention & control team member and HEI member)
- What factors influence the learning of aseptic technique in the university setting? (student, Infection prevention & control team member & HEI member)
- What factors influence the learning of aseptic technique in the clinical setting? (student, mentor, Infection prevention & control team member & HEI member)
- What factors influence the teaching of aseptic technique in the university setting? (student, Infection prevention & control team member & HEI member)
- What factors influence the teaching of aseptic technique in clinical setting? (student, mentor, Infection prevention & control team member & HEI member)
- What factors influence the practice of aseptic technique in the university setting? (student, Infection prevention & control team member & HEI member)

- What factors influence the practice of aseptic technique in the clinical setting? (student, mentor, Infection prevention & control team member & HEI member)
- What assists the transfer of aseptic technique skills from the university to the clinical setting? (student, mentor, Infection prevention & control team member & HEI member)
- What hinders the transfer of aseptic technique skills from the university to the clinical setting? (student, mentor, Infection prevention & control team member & HEI member)

Level 2: Sample of broad questions of enquiry asked of each case

- Is there common understanding of the term ‘aseptic technique’?
- What value is placed upon aseptic technique in practice?
- Is aseptic technique practice principle driven?
- What is student‘s experience of learning and practising aseptic technique?
- Is there parity between what students are taught about aseptic technique in the university and what they observe in clinical practice?
- What is the nature of the relationship and links between the HEI and associated health board/NHS trust and how does this affect aseptic technique education, training and practice?
- What input does the infection prevention and control team have into the design and delivery of education and training in aseptic technique in the pre-registration programme?
- What effect do current roles have upon education and training in aseptic technique in the university and clinical setting?
- What effect do current organisational structures and priorities have upon education and training in aseptic technique in the university and clinical setting?

Level 3: Sample questions asked of the pattern of findings across multiple cases

- Are there any differences in the findings across the cases?
- Are there any similarities in the findings across the cases?
- Are there organisational differences which may account for the difference in findings between the cases?
- Are organisational roles and priorities different or the same across the cases?
- Is a standardised aseptic technique being taught and/or practised across cases

APPENDIX 9-Phase two interview guide

In-depth Interview Guide

Introduction

- Introduce self & study
- Aim and purpose of the interview
- Check interviewees' understanding of the purpose of the study

Interview brief

- Describe format and length of interview
- Remind the interviewee that taking part is voluntary and the interview can stop at any time
- Confidentiality/disclosure of information
- Inform the interviewee that their views and experiences are important and they have an opportunity to ask questions during the interview
- Gain permission to record interview
- Ask if they have any questions about the interview

Interview warm-up

Interview

The broad topic areas that might be covered during the interviews of students (S), mentors (M), higher education institute (HEI) staff members (HEI) and infection prevention and control (IPC) team members are identified below;

- Defining and clarifying understanding of the term 'aseptic technique'(S, M, HEI & IPC)
- Exploring the principles that guide aseptic technique (S, M, HEI & IPC)
- Exploring the importance of aseptic technique in patient care (S, M, HEI & IPC)
- Experiences of learning (S)/teaching (HEI & IPC)/practice (S, HEI & IPC) of aseptic technique in the university setting
- Experiences of learning (S)/teaching (M & IPC)/practice (S, M & IPC) of aseptic technique in the clinical setting
- Identifying factors that influence the learning (S, HEI & IPC)/teaching (HEI & IPC)/practice (S, HEI & IPC) of aseptic technique in the university setting
- Identifying factors that influence the learning (S, M, HEI & IPC)/teaching (M, HEI & IPC)/practice (S, M & IPC) of aseptic technique in the clinical setting.
- Identifying factors that influence the transfer of aseptic technique skills from the university to the clinical setting (S, HEI, M & IPC)
- Exploring the relationship between the university and Health board/NHS trust and how this might impact on education and training in aseptic technique (S, HEI, M & IPC)

Closing the interview

- Check if there is anything that the interviewee would like to add
- Remind and check the interviewee's understanding of what will happen to the data
- Thank the interviewee for taking part in the study

APPENDIX 10- Phase two Observation schedule

Session details

Date:

Title/Focus of session:

Type of session/setting:

Teaching & learning methods

Principle led approach taught? Yes/No

Step by step approach taught? Yes/No

Other approach? Please describe

Teaching of aseptic technique follows Royal Marsden? Yes/No

Teaching of aseptic technique follows Clinical Skills net? Yes/No

Teaching of aseptic technique follows ANTT Clinical Practice Framework? Yes/No

Which of the following ANTT principles/safeguards are discussed/applied?

	Tick √ or cross X
P1. Asepsis is the aim for all invasive clinical procedures	
P2. Asepsis is achieved by key part & key site protection	
P3. Aseptic technique needs to be efficient as well as safe	
P4. To determine surgical or standard ANTT risk assessment is based on the technical difficulty of achieving asepsis	
P5.Aseptic technique should be standardised	
P6. Effective board level leadership, IPC staff training, safe environment and equipment fit for purpose	
Safeguard 1-Basic infective precautions (hand cleaning & decontamination of medical devices)	
Safeguard 2-Identification and protection of key sites & key parts	
Safeguard 3-Non-touch technique	
Safeguard 4-Aseptic fields protect key sites and key parts from the immediate environment (critical aseptic fields or general & micro critical aseptic fields	

Are other principles of aseptic technique identified? If so list

Is the use of terminology consistent with the ANTT clinical practice framework? Yes/No

Is a demonstration provided? Yes/No

Field notes

Practice & performance of aseptic technique

Do students get an opportunity to practice? Yes/No

Duration of practice time:

If yes, do all students get to practice? Yes/No

Are any common difficulties observed or reported by students?

Are any common breaches in aseptic technique observed during practice?

How do students receive feedback on their performance?

Field notes

Assessment

Are students assessed on their knowledge and understanding? Yes/No

Are students assessed on their performance? Yes/No

If yes to 2, is the ANTT Direct Observation of Practice (DOPS) assessment criteria used? Yes/No

Field notes

APPENDIX 11- Coding of interview data

Coding example using one student interview transcript

Code	Example
Lack of recall and retention	I think unless you've done it a couple of times or you retain information really well, I can't remember as much of it
Lack of knowledge and understanding	sometimes I'm thinking well is it clean or is it aseptic? ...if we'd had a little bit more teaching on it then maybe it wouldn't be so much of a grey area, we would know.
Confusion	the e learning one , a lot of it I found it could be quite confusing
Challenging poor practices	I said to the nurse, I said, oh shouldn't we be using sterile gloves and she said no it's fine.
Opportunity for assessment	I got assessed, I would have been signed off on it in my first year probably, on district, and then it's just the e learning package but we don't actually have like a lecturer assess us.
Complacency	in hospital I find it's not as strict, ...they're a bit more blasé about it
Difficulty in mastering aseptic technique	so you should like pass it and then grab it from the other hand and then I do think oh I forget to do it and I've got to stop myself so I think it's taking the time to slow down and you know, making sure that you are carrying it out aseptically
Following the practice of others	it depends who you go with, like you obviously, for us we're taught by mentors and if they've got that practice then you pick it up.
Association of use of aseptic technique	You make sure there's a cap on the end and if somebody got a venflon you make sure the cap is closed and we get taught all that but I just don't really associate it with the aseptic technique.
Use of different terminology	you don't have to do sterile technique on one because the end would be covered

Code	Example
Not up to date or teaching best practice	go out and learn it in practice because they don't necessarily always have the best technique
Opportunity to learn/practice in university	we never really got taught how to catheterise in uni
Reliance on learning in practice	...you've got to learn that out on placement and it's really daunting.
Learning it the right way	I've never done it where I've gone somewhere and they've said, no, they've taught you wrong.
Learning or following the steps	we were in the skills room ...they said how you put your apron, how you put your gloves on, how you clean the trolley down and that was about it
Learning or applying the same principles	It should be the same, the principles are the same.
ANTT specific principles	I can't remember the word, it's like micro field and then like macro field
Clean and dirty principle	when I went out on my district placement then they teach you clean hand, dirty hand.
Doing it the right way	unless you've read around the subject, you know you could just think well I'm doing it right
Doing it the wrong way	maybe you went to another clinical area and then they could say well no you're doing it wrong
Prevention of infection	you could give them a urinary tract infection from catheterising them and not following the aseptic technique
Differences between hospital and community	like district they were really good there and they had sterile gloves and make sure the field was clean whereas in the clinical setting I didn't come across doing a leg dressing that way ...when I done surgical ward. I think district was better.

Code	Example(s)
Avoidance of contamination or transfer of micro-organisms	you would be picking up something clean in your one hand and then say you wipe the area and then pick up something clean off the sterile area with that same hand, if there's anything on that hand you've then contaminated your sterile field if you was to catheterise somebody you would be preventing them organisms getting into the urinary tract
Understanding of principles	if you were changing a wound dressing it would be trying not to touch that field to prevent the transfer of organisms.
Understanding of the procedure	An aseptic technique isn't just using sterile equipment, it can be classed as using clean equipment as well.
Level of competency	I know my aseptic technique needs improving
Depth and focus of teaching	I think for me it should be more in depth in university, we should have been taught you know, this is how you do it
Learning preferences	I learn better being shown, that's why I like being out on placement, I can't sit in a lecture theatre all day, ...I find, it's not engaging enough whereas practical is, it's much better, it's more hands on and I find I learn better like that.
Opportunity to learn/practice in clinical practice	Not having the opportunity to do it, that's probably the biggest thing of it because it depends like where you're placed
Revisiting learning	Since our first year in uni to two months ago, that's probably the first bit of aseptic technique we've done again since then. It's a bit of a break in between, they should at least touch down on it again in your second year
Motivation	I want to work on a surgical ward so I need to know how to do it and I'm looking at it for my dissertation so for me, I want to learn a bit more about it
Controlling environmental risks	..the patient's surroundings, so you shouldn't shake..... so there's no dust particles ... you know the environmental factors like shaking the curtains

The different codes n=96 generated from the interview dataset

Lack of knowledge and understanding	Level of competency	Newly qualified nurses better	Influence of patients
Good knowledge of understanding	Good AT in my ward area	Senior or experienced nurses better	Difference in reality between simulated environment and clinical practice
Level of knowledge and understanding	Difficulties in Mastering AT skills	Senior or experienced nurses worse	Reliance upon learning in clinical practice
Lack of understanding of the differences between aseptic technique and ANTT	Limited opportunity for assessment of AT	Following the practice of others	Revisiting learning of AT
Lack of understanding of different terminology for AT	Lack of knowledge and understanding of the meaning of principles	Not influenced by others	Loss or lack of emphasis on AT
Lack of understanding of clean, sterile and aseptic terms	Learning or following the steps	Modifying practice to fit in	Depth and focus of learning
Different AT terminology	Taking extra steps	Influence of Peers	Motivation
Complacency	Lack of knowledge and understanding of the meaning of principles	Availability and use of equipment	Learning preferences
Confusion	Learning and applying the same principles	Learning resources	Personality of student
Association of use of AT	Adaptation to the environment or situation	Too busy not enough time	Taking responsibility for learning

The different codes n=96 generated from the interview dataset (continued)

Lack of recall and retention of learning	Adaptation in emergency situations	Group size	Challenging practices
Use of made up terms/own language	Doing it the right way	Staffing	Relationship between staff and IPC team
Importance of AT	Doing it the wrong way	Interruptions to AT	Opportunity to review and audit AT practice
Understanding of the aim	Learning the right way	Assessment of prior knowledge and skills	Maintaining standards of AT
Understanding of the Principles	Learning the wrong way	Level of supervision and feedback	IPC involvement or relationship with students
Understanding of the Procedure	Difficulties in Mastering AT skills	Influence of the built hospital environment	Relationship between partner organisations and Universities
Differences between hospital and community	Level of competency	Opportunities to learn and practice AT in university	Roles and responsibilities for teaching, education and assessment
Controlling environmental risks	Good AT in my ward area	Placements	Lack of education and training updates in AT
Differences or variations in AT	Difficulties in mastering AT	Prior learning experiences	Not up to date/teaching best practice
No variations in AT taught & seen in practice	Influence of mentor/teacher	Picking up bad habits	Influence of initial training
Need for a standardised approach	Newly qualified nurses worse	Not following policy/guidelines	Learning/teaching AT from scratch
Prevention of infection	Protection of patient	Avoidance of contamination or transfer of micro-organisms	ANTT principles
Protection of health professional	No reason for importance	Opportunities to learn and practice AT in clinical practice	Clean and dirty principle

APPENDIX 12- Summary of Phase two data sources and findings from observational and documentary evidence

Breakdown of data sources for Case-Study Site 1

Case-study Site 1		
	Interview data	Documentary Evidence
University	n=8 students n=4 HEI staff members	Student Record of Generic Skills Development Clinical practice assessment document Year 1/2 Adult simulated scenario session
NHS Trusts	**A** n=2 Infection prevention nurses n=2 mentors **B** n=3 Infection prevention nurses n=4 mentors **C** n=3 Infection prevention nurses	**A** Peripheral vascular Cannulae & Urinary Catheter Surveillance policy Peripheral Line Protocol **B** Peripheral Intravenous Cannulation Policy & Procedure Urinary catheterisation policy Venepuncture & Taking Blood Cultures Policy **C** No policies retrieved

Breakdown of data sources for Case-Study Site 2

Case-study Site 2		
	Interview data	Documentary Evidence
University	n=7 students n=3 HEI staff members	1st year Aseptic Technique (Non-Touch Technique) PowerPoint Presentation 2nd Year OSCE Scenarios & assessment documents x3 3rd Year Community Visit Scenario for Student Led Session information Year 1, 2 and 3 Essential Skills Document
NHS Trusts	**D** n=2 mentors **E** n=4 IPC nurses n=1 mentor **F** n=1 IPC nurse n=1 mentor **G** n=1 IPC nurse n=1 mentor	No documents retrieved No documents retrieved No documents retrieved Asepsis policy Asepsis in the Community; Aseptic Non-Touch technique training Powerpoint presentation Long-term Urinary Catheters: Prevention and Control of Healthcare-Associated Infections in Community Care training Powerpoint presentation

Description of teaching sessions observed at Case-Study Site 1

Case-Study Site 1
Year one
Two sessions were observed where students had an opportunity to practice aseptic technique applied to injection technique and wound care. Aseptic technique was not the prime focus of any of these sessions. Session 1- Injection technique was part of a medicines management session. This took place in a classroom prior to students' first clinical placement. Students practised individually using an injection training model under the supervision of two facilitators. Session 2-Performing aseptic technique in wound care was part of a simulation, managing an adult with learning disabilities, following a seizure. Students practised dressing a laceration on a manikin in the simulated ward in groups of 2-4 students, supervised by one facilitator. Students had not previously practised an aseptic technique in wound care in university but, having completed two placements might have practised this in clinical placements.
Year two
No sessions observed
Year Three
In Case-Study Site 1, students had a theory and practical session on trachestomy care. Students practised an aseptic technique when dressing a tracheostomy site in groups of 4-5 students in the simulated ward, supervised by one facilitator.

Description of teaching sessions observed at Case-Study Site 2

Case-Study Site 2
Year one
Students had a combined theory and practical session upon aseptic technique in wound care prior to their first placement. A Powerpoint presentation and practical demonstration of an aseptic technique in the acute setting were given. Each student practised donning gloves and opening up wound packs under the supervision of one facilitator.
Year two
Insertion of a female catheterisation station, was one of four 25 minutes practice stations in a year two, continence session. Students in groups 3-4, practised applying an aseptic technique at the female catheterisation station on a training model. One facilitator supervised all stations.
Year Three
Students had a community visit scenario to work through. Students were required to assess, plan and implement wound care for an immobile patient with a pressure sore. Students practised an aseptic technique in groups of 4-5, with a trolley under the supervision of one facilitator.

Case-Study Site 1-aseptic technique teaching sessions & periods of observation

	Aseptic technique sessions					
Year	Session	Duration (hrs)	No. of observations	Date	No. of facilitators observed	Total Observation Time (hrs)
1	Lecture- aseptic technique & aseptic technique in wound care & Video	1				**-**
	Medication management (subcutaneous & intramuscular injections)	3	1	3/11/16	2	3
	Simulated scenario of an adult following a seizure including wound care	3	3	6/1/16 13/1/16 20/1/16	2 3 2	9
2	Optional skills session - urinary catheterisation & Video	2				-
3	Care of tracheostomy & Video	3	2	11/1/16 1/2/16	1 1	6
	Intravenous infusions	2				
Total		**14**	**6**		**11**	**18**

Summary of each observation of teaching at Case-Study Site 1

	Observation period									
	1 3/11/16	**2 6/1/16**		**3 11/1/16**	**4 13/1/16**			**5 20/1/16**		**6 1/2/16**
Facilitators (1-7)	1 & 2	3	2	4	5	6	2	7	4	4
Ratio of facilitators to students	2:16	1:3	1:3	1:25	1:3	1:2	1:2	1:4	1:6	1:25
Teaching approach (Key Y- Yes N –No)										
Principle led approach	N	N	N	N	N	Y	N	N	Y	N
Procedural/step by step approach	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Full practical demonstration given	Y	N	N	N	N	Y	N	N	N	N
Comments			Refers to steps as principles			Different approaches discussed			Demo of cleaning trolley only	
Reference to/use of guidelines										
Royal Marsden	Y	N	N	N	N	N	N	N	N	N
Clinical skills.net	N	N	N	Y	N	N	N	N	N	N
ANTT Clinical Practice Framework	Y	N	N	N	N	N	N	N	N	N
Other	Y	N	N	Y	N	N	N	N	N	N
ANTT principles(P)/safeguards(S) taught or similar										
P1. Asepsis is the aim for all invasive clinical procedures	N	N	N	N	N	N	N	N	N	N
P2. Asepsis is achieved by key part & site protection	N	N	N	N	N	N	N	N	N	N
P3. Needs to be efficient & safe	N	N	N	N	N	N	N	N	N	N
P4. Risk assessment for surgical or standard ANTT	N	N	N	N	N	N	N	N	N	N
S 1. Basic infective precautions	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
S 2. Identification & protection of key sites & parts	N	N	N	Y	N	N	N	N	Y	Y
S 3. Non-touch technique	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
S 4. Aseptic field management	N	N	N	N	N	N	N	N	N	N

	Observation period									
	1 3/11/16	**2 6/1/16**		**3 11/1/16**	**4 13/1/16**			**5 20/1/16**		**6 1/2/16**
Facilitators (1-7)	1 & 2	3	2	4	5	6	2	7	4	4
Other principles taught (Key Y- Yes N –No)										
Clean hand, dirty hand	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
One wipe and discard	N	Y	Y	Y	N	N	Y	N	Y	Y
Sterile items should not be in contact with non-sterile items	N	N	N	Y	N	Y	N	N	Y	Y
Comments										
Use of ANTT specific terminology	N	N	N	Y	N	N	N	N	Y	Y
Evidence of ANTT knowledge being taught										
ANTT definition of asepsis	N	N	N	N	N	N	N	N	N	N
States the ANTT risk assessment question	N	N	N	N	N	N	N	N	N	N
Discusses the risks to be considered	N	N	N	N	N	N	N	N	N	N
Identifies different types of aseptic fields in ANTT	N	N	N	N	N	N	N	N	N	N
Definition of a Key-Part	N	N	N	Y	N	N	N	N	N	N
Definition of Key-SITE	N	N	N	Y	N	N	N	N	N	N
Discusses Key-Part / Key-Site *'Rule'*	N	N	N	N	N	N	N	N	N	N
Discusses two different types of ANTT	N	N	N	N	N	N	N	N	N	N
Other knowledge is taught										
Other definitions of asepsis provided	N	N	N	N	N	N	N	N	N	N
Comments		Checked students had completed ANTT e-learning				Adaptation to the community	Facilitator discussed trolley being 'sterile' then 'clean'	Adaptation to the community different situations discussed	Adaptation to the community discussed Trolley clean not sterile	

	Observation period									
	1 3/11/16	**2 6/1/16**		**3 11/1/16**	**4 13/1/16**			**5 20/1/16**		**6 1/2/16**
Facilitators (1-7)	1 & 2	3	2	4	5	6	2	7	4	4
Practice (Key Y- Yes N –No)										
Do students get opportunity to practice?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Do all students get to practice the full procedure?	Y	N	N	N	N	Y	N	N	N	N
Practice 1 or 2 person technique	1	2	2	1	2	1	2	2	2	1
Duration of practice time	30 mins	30 mins	30 mins	20-30 mins	30 mins	40 mins	30 mins	40 mins	30 mins	30 mins
Any common difficulties observed/reported by students?	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Donning gloves	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Clean hand dirty hand	N	Y	Y	Y	N	N	Y	N	Y	Y
Breaches in aseptic technique?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Areas of contamination/poor practice	Needle in tray	Gloves	Disposal bag on bed	-Gloves -Disposal bag on bed	Sterile field,& fluid waste on chair,	Gloves	Gloves, Sterile field, cleaning fluid, disposal bag on bed	Gloves, Sterile field &cleaning fluid	Gloves & sterile field	-Gloves, sterile field & waste left on bed
Feedback &Assessment										
Students receive facilitator feedback on their performance?	Y	Y	Y	N	Y	Y	Y	N	Y	Y
Students receive other feedback on their performance?	N	N	N	N	N	N	N	N	N	N
Comments	Classroom based-no sinks, gloves or aprons used		Extra steps hand-washing, use of gloves & aprons	No time to de-brief or feedback		Students made hand conscious	Made aware of contamination Extra steps taken as on 6/1/16	Students looking for feedback -20mins spent cleaning trolley	What is sterile or not & told to start again if they contaminate	Highlighted areas of contamination Demo of opening equipment & donning gloves
Assessment of knowledge & understanding?	N	N	N	N	N	N	N	N	N	N
Assessment of performance?	N	N	N	N	N	N	N	N	N	N

Case-Study Site 2-Aseptic technique teaching and assessment sessions and periods of observation

Year	Session	Duration (hrs)	Number of observations	Date	No. of facilitators observed	Total Observation Time (hrs)
1	Aseptic technique in wound care (theory & practical) & Video	3	1	8/1/16	1	2
	Optional open clinical skills laboratory session	2				-
2	Continence session including urinary catheterisation	2	2	11/3/16 am pm	1	4
	Infusions	2				-
	Suture removal	2				-
	OSCE (4 stations) Examination	6	1		2	6
3	Community visit scenario (wound assessment & care)	3	1	1/12/15	1	3
	Venepuncture theory & practice	3				-
	Catheterisation	3				-
	Infusions	3				-
Total		**29**	**5**		**5**	**15**

Summary of each observation of teaching at Case-Study Site 2

	Observation period			
	1 **1/12/16**	**2** **8/1/16**	**3** **11/3/16** **Am**	**Pm**
Facilitator 1-3	1	2	3	3
Ratio of facilitators to students	1:13	1:25	1:16	1:16
Teaching approach (Key Y- Yes N –No)				
Principle led approach	N	N	N	N
Step by step approach	N	Y	Y	Y
Practical demonstration given	N	Y	N	N
Comments	Student led community scenario session	Extra hand-washing, glove & apron use & facilitator contaminated hands & forgot to open dressing	One skills station insertion of female catheterisation	One skills station insertion of female catheterisation
Use or reference to guidelines				
Royal Marsden	Y	N	Y	Y
Clinical skills.net	N	N	N	N
ANTT Clinical Practice Framework	N	Y	N	N
Other	N	N	N	N
Comments	Procedural guidelines for reference	ANTT in reference list	Procedural guidelines at station	
ANTT principles (P)/safeguards (S) taught or similar				
P1. Asepsis is the aim for all invasive clinical procedures	N	Y	N	N
P2. Asepsis achieved by key part & site protection	N	N	N	N
P3. Needs to be efficient & safe	N	N	N	N
P4. Risk assessment for surgical or standard ANTT	N	N	N	N
S 1. Basic infective precautions	Y	Y	Y	Y
S 2. Identification & protection of key sites & parts	N	N	N	N
S 3. Non-touch technique	Y	Y	Y	Y
S 4. Aseptic field management	N	N	N	N

	Observation period			
	1 **1/12/16**	**2** **8/1/16**	**3** **11/3/16 am**	**4** **11/3/16 pm**
Facilitator 1-3	1	2	3	3
Other principles taught (Key Y- Yes N –No)				
Clean hand, dirty hand	Y	Y	Y	Y
One wipe and discard	Y	Y	N	N
Sterile items/field should not be in contact with non-sterile items	N	N	N	N
Comments	Students identified the above principles	Talk of principles but steps shown		
Use of ANTT specific terminology	N	N	N	N
Evidence of ANTT knowledge being taught				
ANTT® definition of asepsis	N	N	N	N
States the ANTT® risk assessment question	N	N	N	N
Discusses the risks to be considered	N	N	N	N
Identifies different types of aseptic fields in ANTT	N	N	N	N
Definition of a Key-Part	N	N	N	N
Definition of a Key-Site	N	N	N	N
Discusses Key-Part / Key-Site *'Rule'*	N	N	N	N
Discusses two different types of ANTT	N	N	N	N
Other knowledge taught				
Other definitions/aim of asepsis provided	N	Y	N	N
Comments	Facilitator talks of use of a clean technique	Facilitator refers to top of trolley as sterile Taught using trolley in acute setting	Facilitator refers to top of trolley as sterile. Students told to double glove or change gloves after cleaning area and aseptic technique could not be done in community as environment different & no trolley but still need to use a sterile field	Facilitator refers to top of trolley as sterile. Students told to double glove or change gloves after cleaning area & aseptic technique could not be done in community as environment different & no trolley but still need to use a sterile field

	Observation period			
	1 **1/12/16**	**2** **8/1/16**	**3** **11/3/16** **Am**	**Pm**
Facilitator 1-3	1	2	3	3
Practice (Key Y- Yes N –No)				
Do students get opportunity to practice?	Y	Y	Y	Y
Do all students get to practice the full procedure?	Y	N	N	N
Practice as 1 or 2 person technique	1	1	2	2
Duration of practice time	25 mins	15 mins	25 mins	25 mins
Any common difficulties observed/ reported by students?	Y	Y	Y	Y
Donning gloves	Y	Y	Y	Y
Clean hand dirty hand	N	N	Y	Y
Breaches in aseptic technique?	Y	Y	Y	Y
Areas of contamination/poor practice	Sterile field, gloves & Wrist & hand jewellery, loose hair	Gloves	Sterile field, gloves & cleaning fluid	Sterile field, gloves & cleaning fluid
Feedback & Assessment				
Did students receive facilitator feedback on their performance?	Limited	Limited	Limited	Limited
Students receive other feedback on performance?	N	N	N	N
Comments	-Students not taking it seriously -Use of trolley for the community -Classroom-no hand-washing facilities	Practice donning gloves and opening up pack only -Classroom-no hand-washing facilities	-Lack of resources (handwashing facilities, gloves) and time to practice -Students not taking it seriously	-Lack of resources (handwashing facilities, gloves) and time to practice
Assessment of knowledge &understanding?	N	N	N	N
Assessment of performance?	N	N	N	N

A summary of observational findings from teaching and assessment sessions

	Case-Study Site	
	1	2
	No. of Observations (n=10)	No. of Observations (n=4)
Teaching		
Type of approach		
Principle led	0	0
Procedural	8	4
Principle led & procedural	2	0
A live practical demonstration is given	2	1
Use or reference to guidelines		
Royal Marsden	1	3
Clinical skills.net	3	0
ANTT	1	0
Other	2	2
Use of ANTT terminology	3	0
ANTT principles/safeguards taught		
Asepsis is the aim for all invasive procedures		1
Identification/protection of key parts & key sites	3	0
Basic Infective Precautions	10	4
Non-touch technique	9	4
Other principles taught		
Clean hand, dirty hand	9	4
One wipe and discard	6	2
Sterile items only in contact with sterile items	4	0
Practice		
All students practice	3	1
Using a 1 person technique	4	2
Using a 2 person technique	6	2
Duration	30-40mins	15-25mins
Common difficulties observed/reported	9	4
Donning gloves	9	4
Use of clean hand dirty hand	6	2
Areas of contamination/poor practice	10	4
Sterile gloves	7	4
Sterile field	5	3
Failure to clean outside of cleaning solution	3	2
Poor waste disposal practices	5	1
Wearing hand jewellery & loose hair	-	4
Feedback & Assessment		
Facilitator feedback on performance	7	4
Other sources of feedback	0	0
Assessment of knowledge & understanding	0	0
Assessment of performance	0	0

Frequency of different aseptic technique terms found in university and NHS trust documents

	Case-Study Site 1			**Case-Study Site 2**		
Term	University Documents (n=3)	NHS Trust documents (n=5)	Total	University Documents (n=8)	NHS Trust documents (n=3)	Total
Aseptic technique	1	8	9	9	11	20
Aseptic non-touch technique	0	3	3	1	4	5
ANTT	0	0	0	0	6	6
Asepsis	2	0	2	1	16	17
Aseptic procedure	0	1	1	1	2	3
Clean	0	17	17	4	6	10
Clean Technique	1	0	1	1	7	8
Clean Procedure	0	1	1	0	2	2
No touch aseptic dressing technique	1	0	1	0	0	0
Non-touch		0	0	5	0	0
Sterile	0	40	40	5	17	22
Modified aseptic technique	0	0	0	0	3	3
Key parts	0	0	0	0	10	10
Key sites	0	0	0	0	6	6